US009108442B2

(12) **United States Patent**
Ito et al.

(10) **Patent No.: US 9,108,442 B2**
(45) **Date of Patent: Aug. 18, 2015**

(54) **IMAGE FORMING APPARATUS**

(71) Applicants: **Yoichi Ito**, Tokyo (JP); **Soyoung Park**, Kanagawa (JP); **Yoshinori Uchino**, Kanagawa (JP); **Mikio Ohashi**, Kanagawa (JP); **Tadayasu Enomoto**, Kanagawa (JP)

(72) Inventors: **Yoichi Ito**, Tokyo (JP); **Soyoung Park**, Kanagawa (JP); **Yoshinori Uchino**, Kanagawa (JP); **Mikio Ohashi**, Kanagawa (JP); **Tadayasu Enomoto**, Kanagawa (JP)

(73) Assignee: **RICOH COMPANY, LTD.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/454,090**

(22) Filed: **Aug. 7, 2014**

(65) **Prior Publication Data**

US 2015/0054897 A1 Feb. 26, 2015

(30) **Foreign Application Priority Data**

Aug. 20, 2013 (JP) 2013-170042
Aug. 20, 2013 (JP) 2013-170101
Jun. 3, 2014 (JP) 2014-115176

(51) **Int. Cl.**
B41J 13/10 (2006.01)
B41J 11/00 (2006.01)

(52) **U.S. Cl.**
CPC ***B41J 11/005*** (2013.01)

(58) **Field of Classification Search**
USPC 347/101, 244
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,257,038	A *	10/1993	Ferschl et al.	347/244
2006/0055754	A1	3/2006	Sakuma et al.	
2006/0164491	A1	7/2006	Sakuma et al.	
2006/0268087	A1 *	11/2006	Sasa	347/101
2007/0109385	A1	5/2007	Imoto et al.	
2009/0058911	A1	3/2009	Kogure et al.	
2012/0081487	A1	4/2012	Tanaka et al.	
2012/0113180	A1	5/2012	Tanaka et al.	
2012/0113204	A1	5/2012	Tanaka et al.	
2012/0187622	A1 *	7/2012	Kamichi	271/171
2012/0187624	A1	7/2012	Ito et al.	
2012/0206552	A1	8/2012	Uchino	
2013/0020753	A1	1/2013	Ito	
2014/0063121	A1	3/2014	Moriwaki et al.	
2014/0092153	A1	4/2014	Kikkawa et al.	
2014/0152745	A1	6/2014	Park	

FOREIGN PATENT DOCUMENTS

JP	63-197156	12/1988
JP	5-050672	3/1993
JP	6-297798	10/1994
JP	11-170643	6/1999
JP	2004-175017	6/2004
JP	2007-118480	5/2007
JP	2007-144633	6/2007
JP	2012-166449	9/2012

* cited by examiner

Primary Examiner — Stephen Meier
Assistant Examiner — John P Zimmermann
(74) *Attorney, Agent, or Firm* — Cooper & Dunham LLP

(57) **ABSTRACT**

An image forming apparatus including an image forming unit, a conveyor, and a string-shaped regulation member. The image forming unit forms an image on a recording medium. The conveyor is disposed opposing the image forming unit to convey the recording medium along a conveyance passage. The string-shaped regulation member is disposed between the image forming unit and the conveyance passage to regulate a distance between the recording medium and the image forming unit within a certain range.

20 Claims, 23 Drawing Sheets

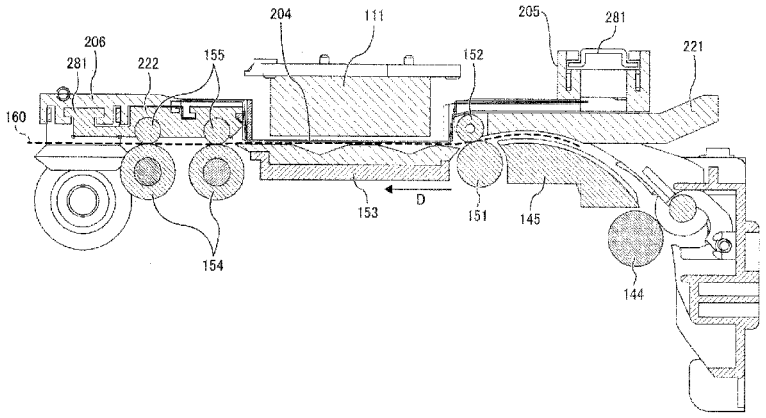

FIG. 1

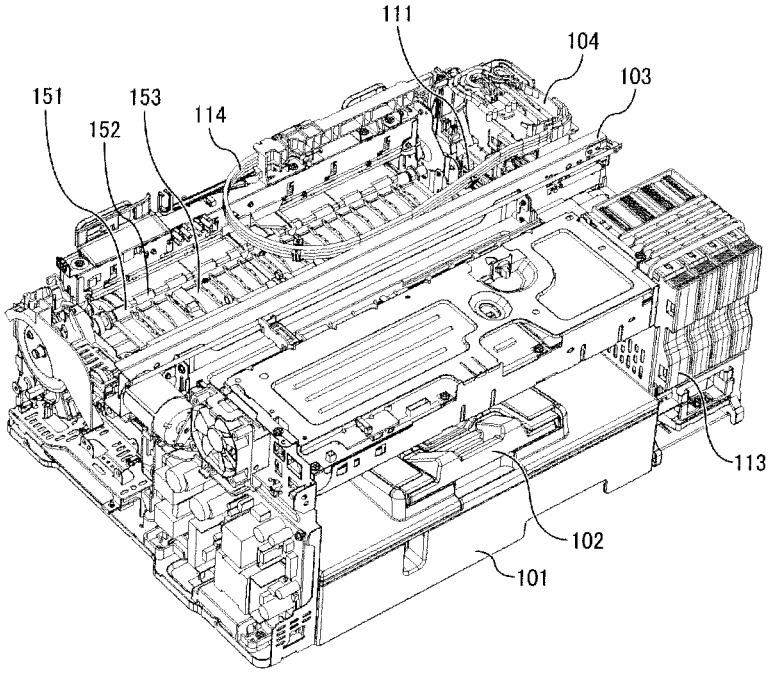

FIG. 2

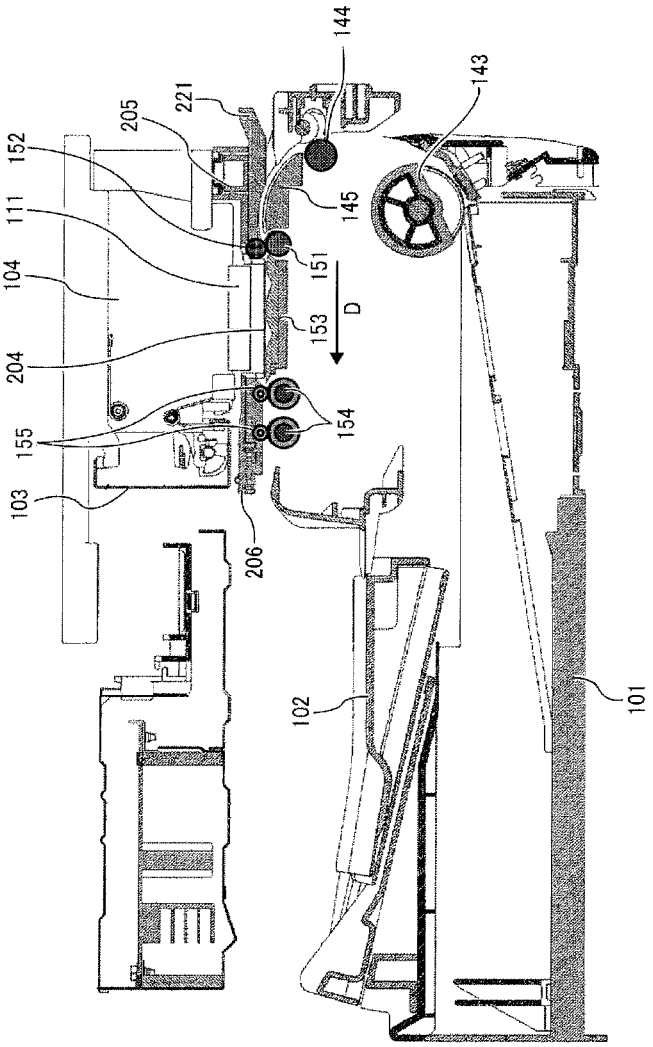
144
143
205
221
152
145
111
151
104
153
D
204
154
155
103
206
102
101

FIG. 3

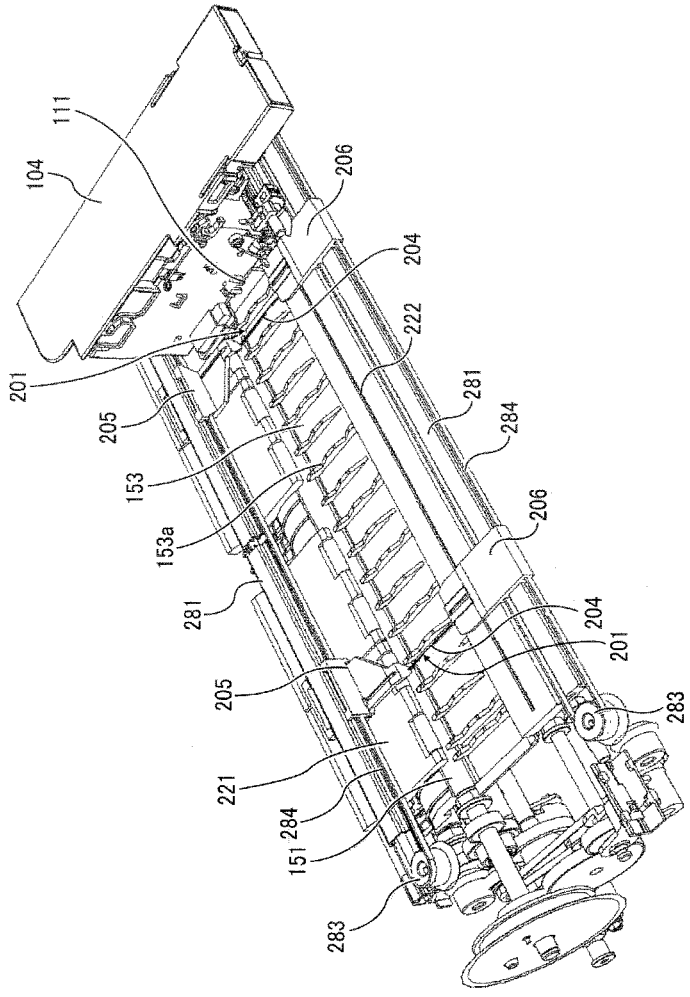
111
104
206
204
222
201
281
205
284
153
206
153a
204
281
201
205
283
221
284
151
283

FIG. 4

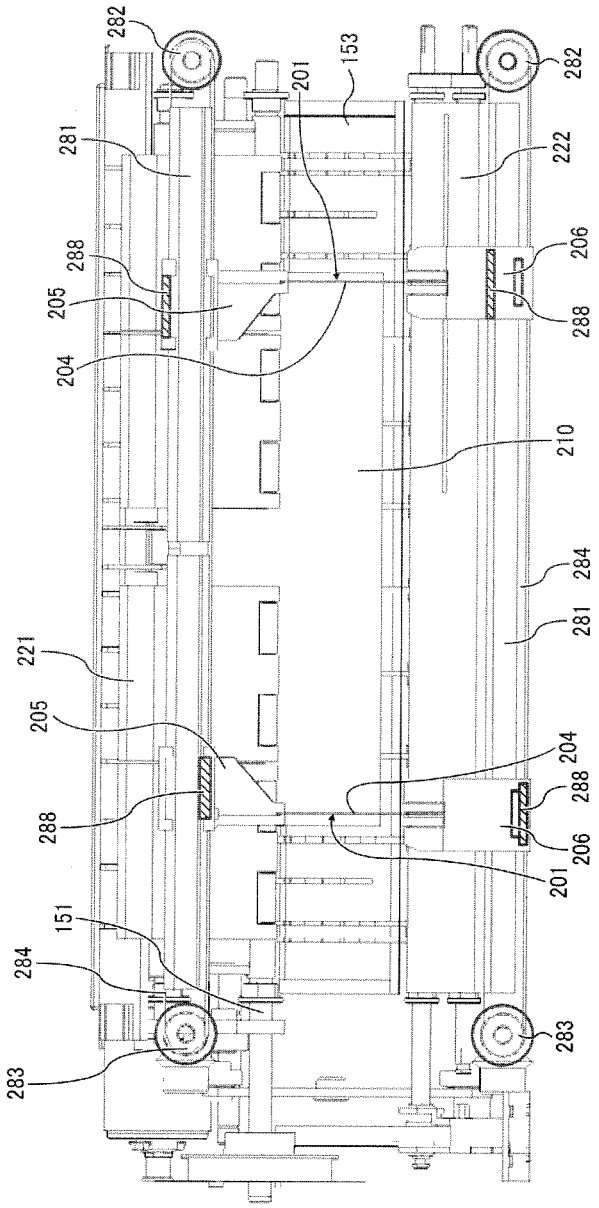
282
153
201
282
281
222
288
206
205
288
204
210
284
281
221
205
204
288
288
206
201
151
284
283
283

FIG. 5A

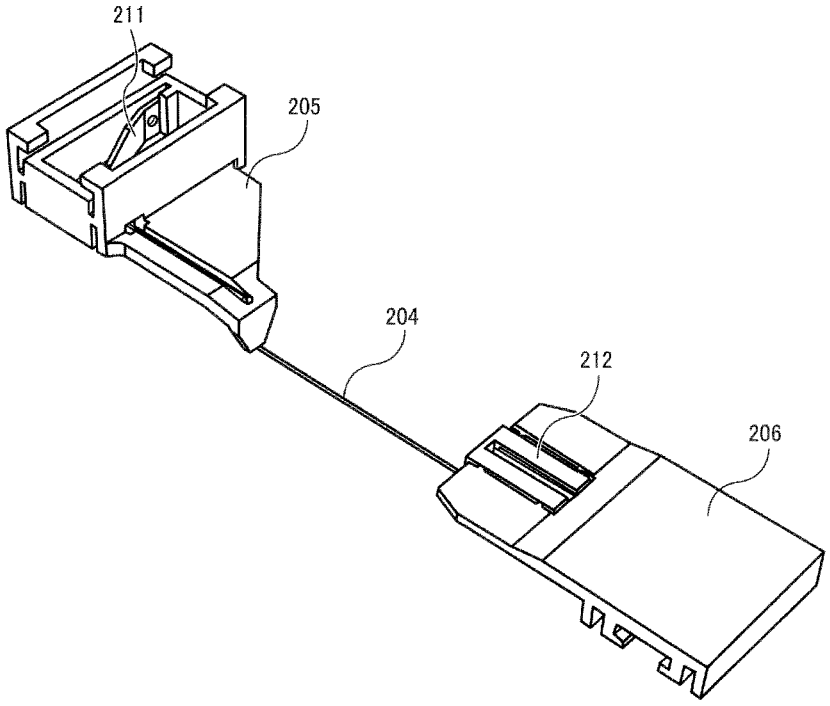

FIG. 5B

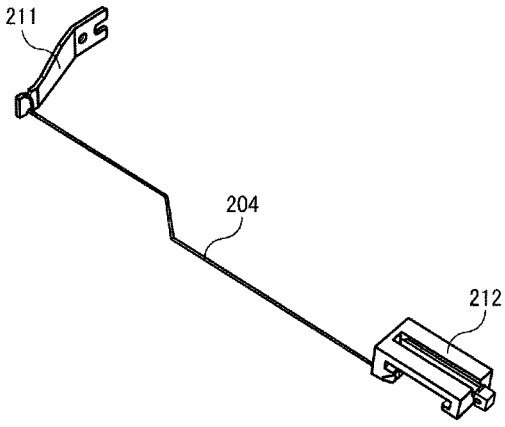

FIG. 6

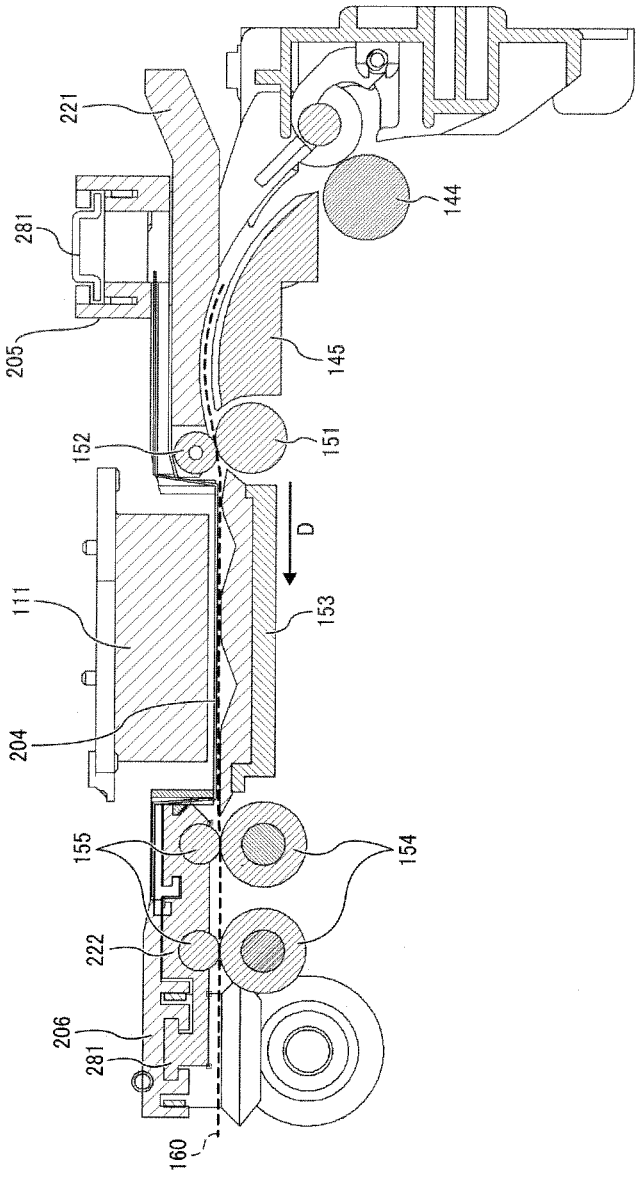

FIG. 7

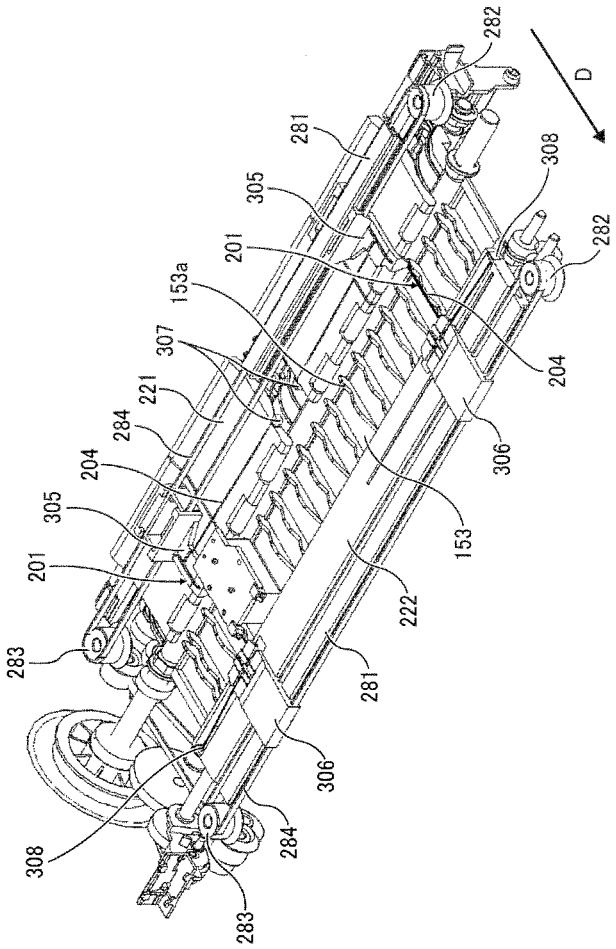
282
D
281
308
305
282
201
153a
204
307
221
284
306
204
305
153
201
222
283
281
306
284
308
283

FIG. 8

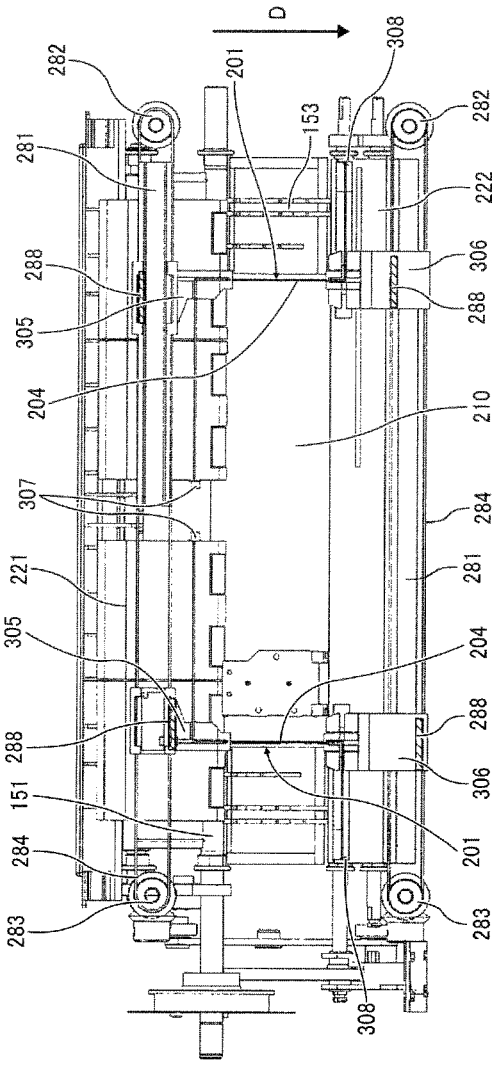
D
282
201
308
153
281
222
288
306
305
204
210
307
284
221
281
305
204
288
288
151
306
284
201
283
283
308

FIG. 9A

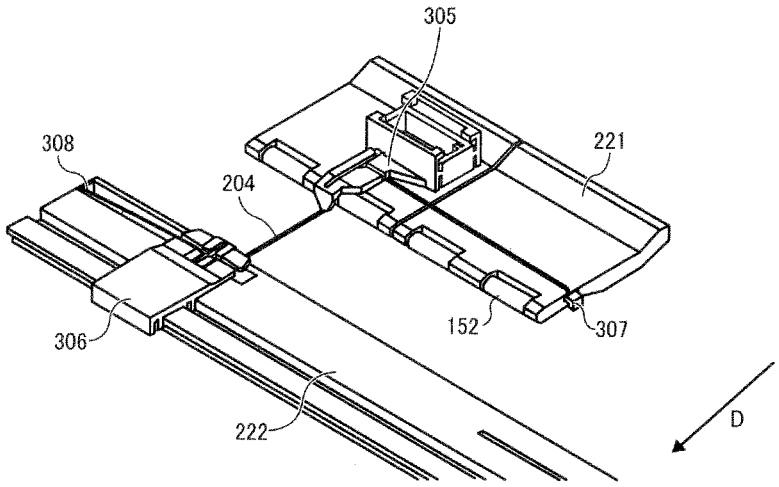

FIG. 9B

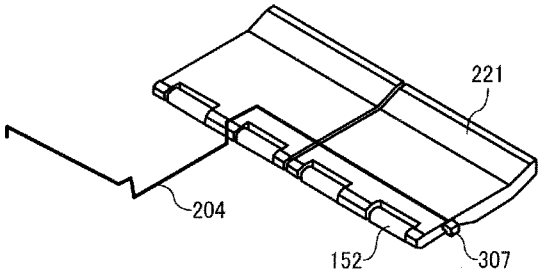

FIG. 10A

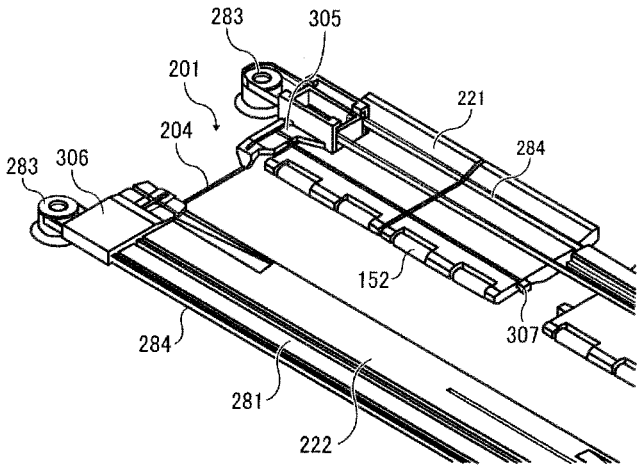

FIG. 10B

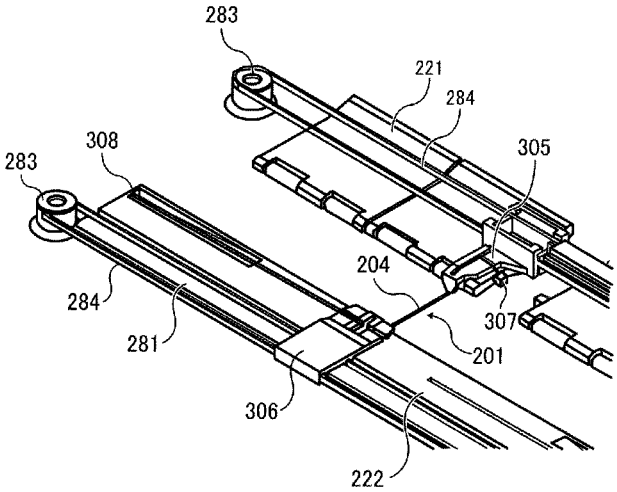

FIG. 11A

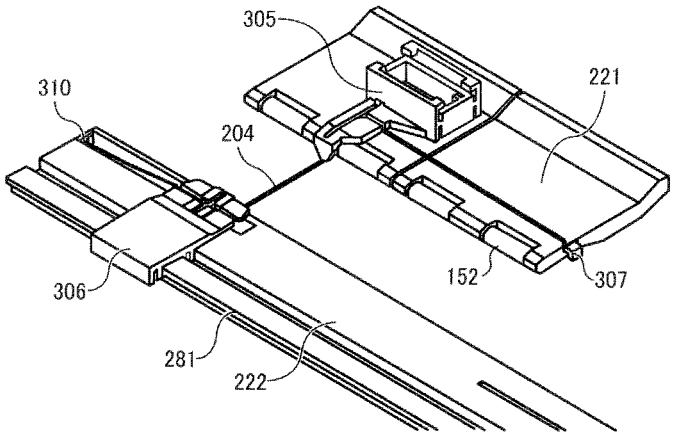

FIG. 11B

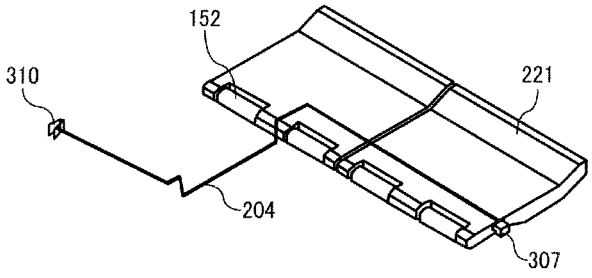

FIG. 12

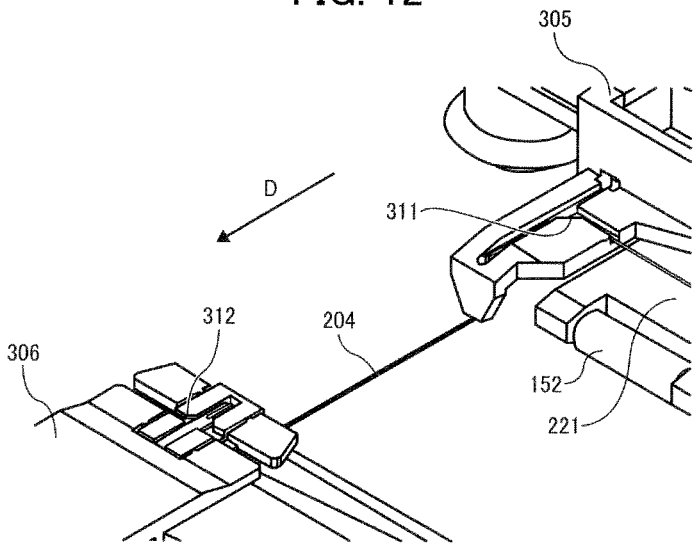
305
D
311
312
204
306
152
221

FIG. 13

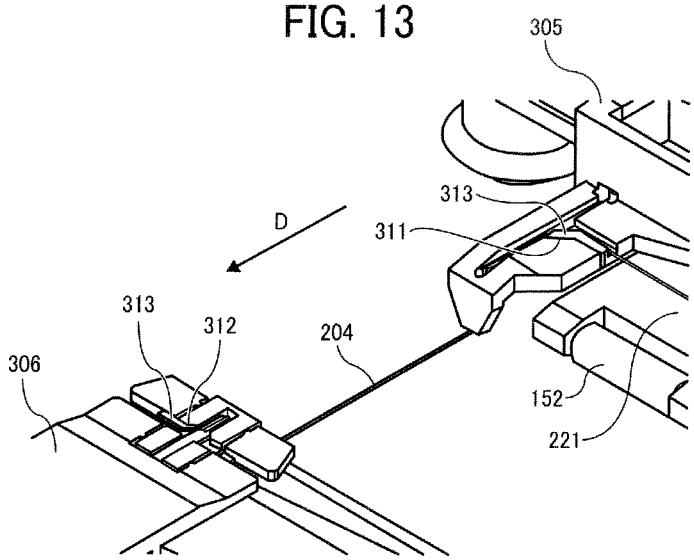
305
313
D
311
313
312
204
306
152
221

FIG. 14

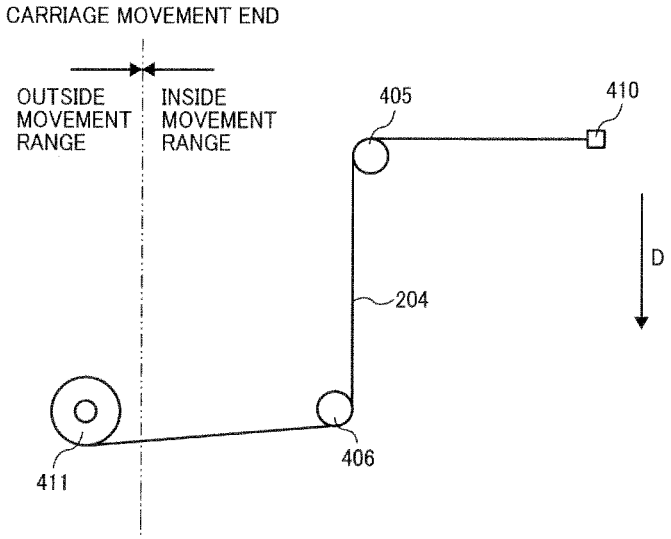
CARRIAGE MOVEMENT END
OUTSIDE MOVEMENT RANGE
INSIDE MOVEMENT RANGE
405
410
D
204
406
411

FIG. 15

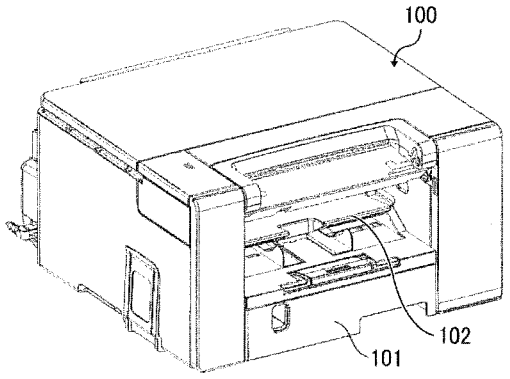
100
102
101

FIG. 16

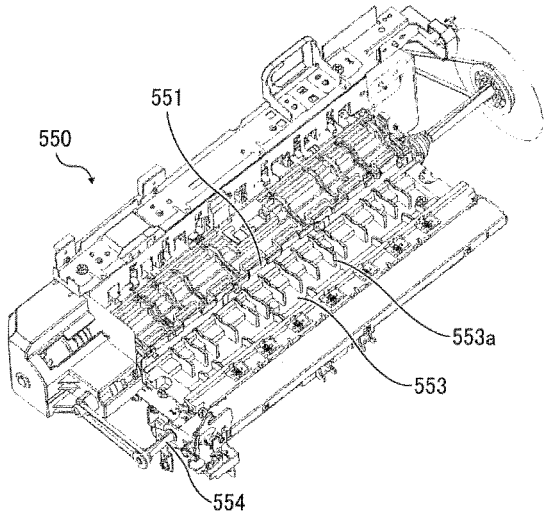
550
551
553a
553
554

FIG. 17

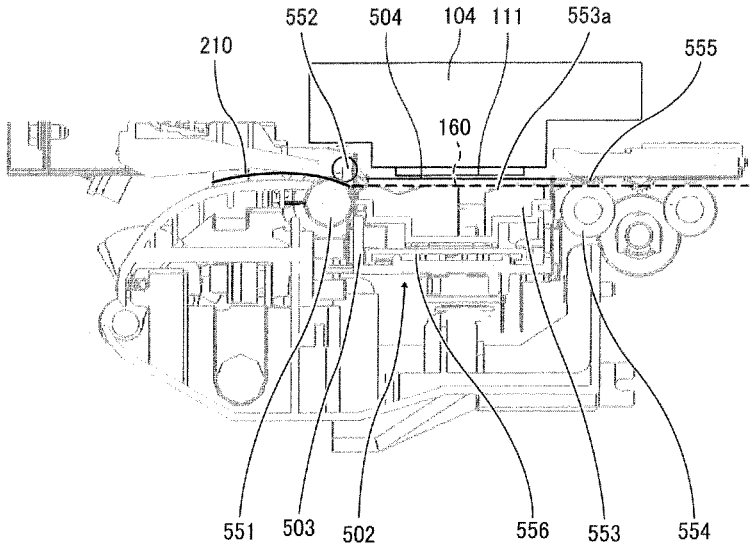
552
504
104
111
553a
210
555
160
551
503
502
556
553
554

FIG. 18

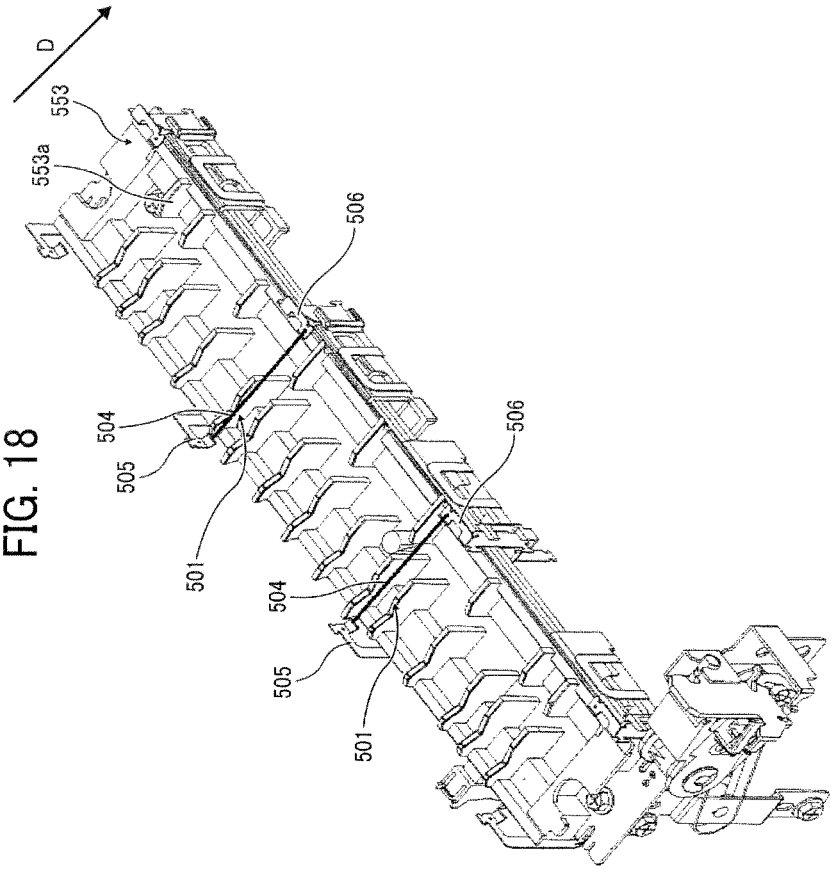

FIG. 19

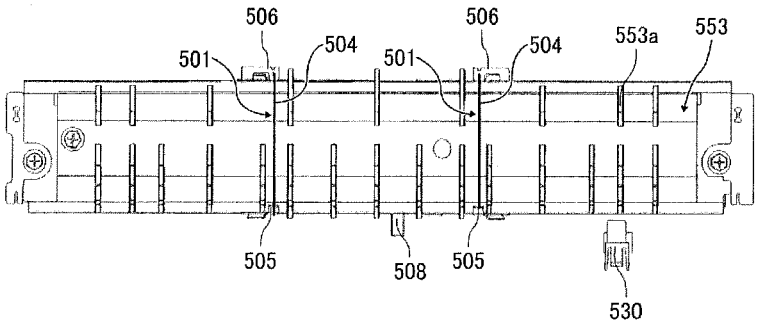
506
504
501
506
504
501
553a
553
505
508
505
530

FIG. 20

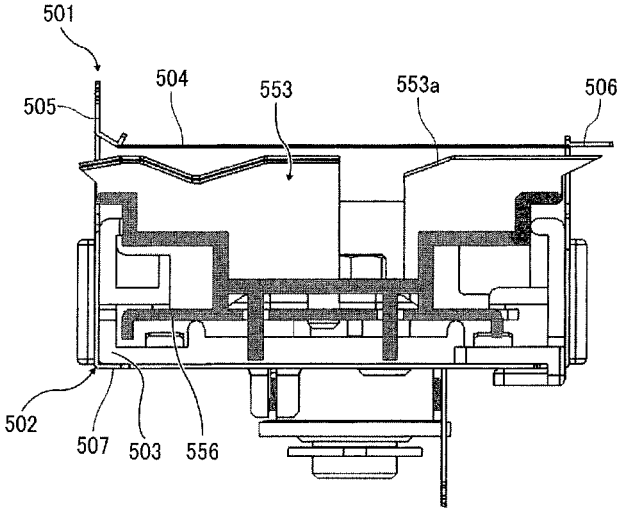
501
504
553
553a
506
505
502
507
503
556

FIG. 21

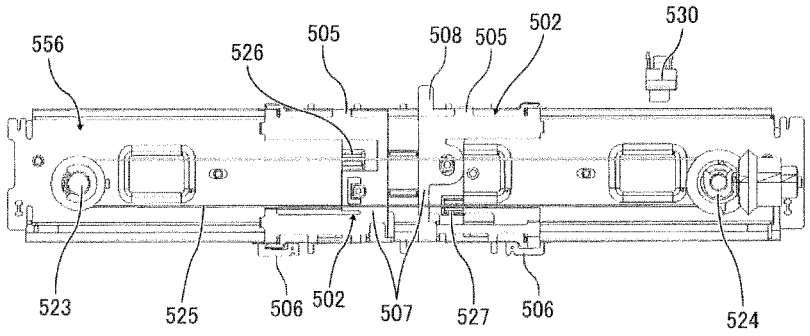
556
526
505
508
505
502
530
523
525
506
502
507
527
506
524

FIG. 22

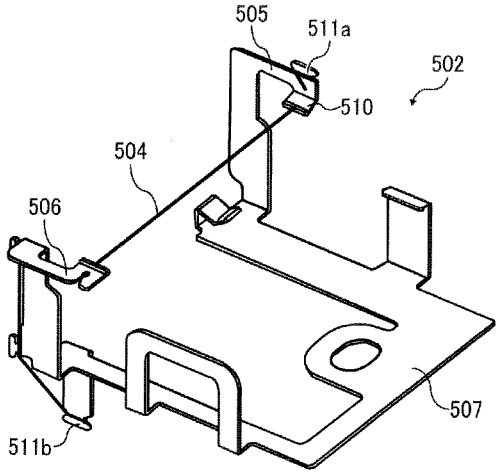
505
511a
502
510
504
506
507
511b

FIG. 23

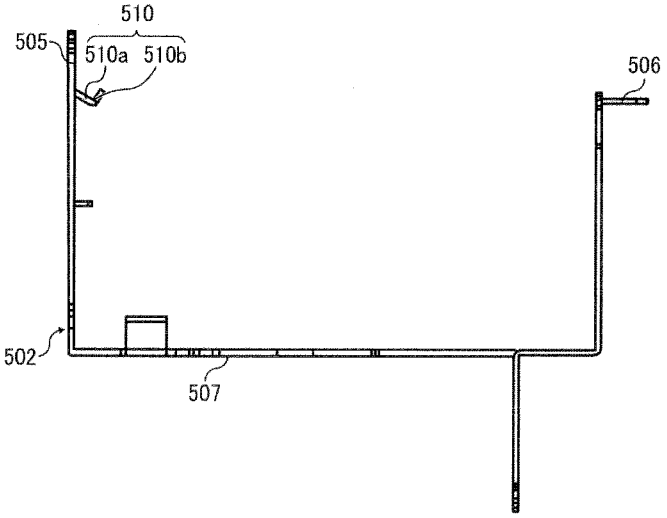
510
505
510a
510b
506
502
507

FIG. 24

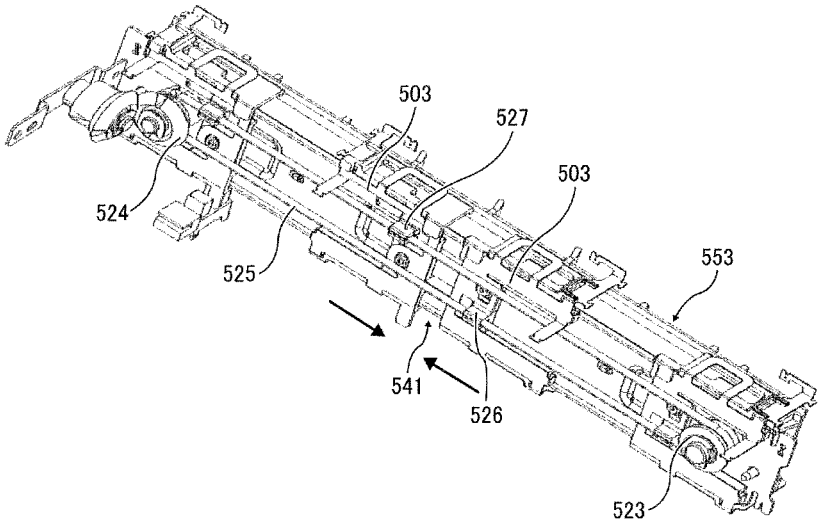
503
527
503
524
525
553
541
526
523

FIG. 25

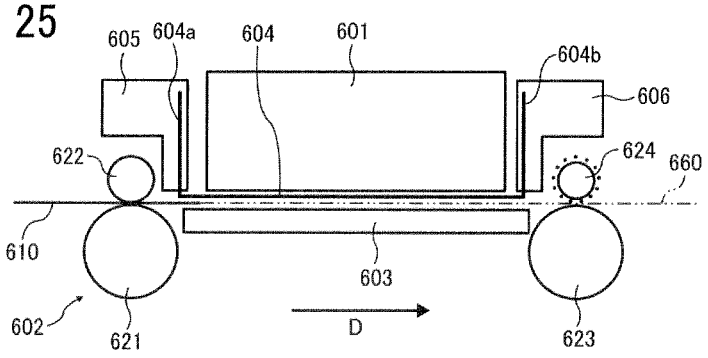

FIG. 26

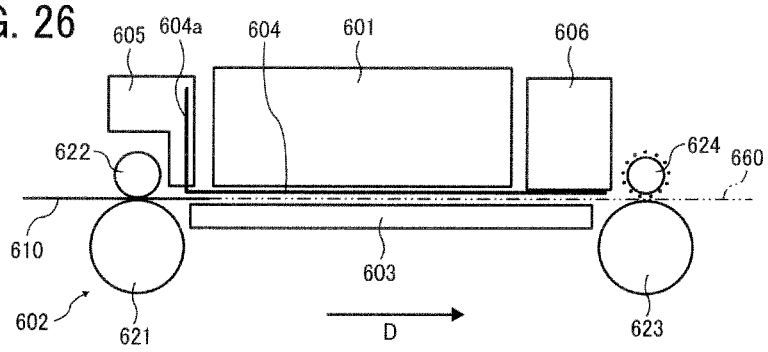

FIG. 27

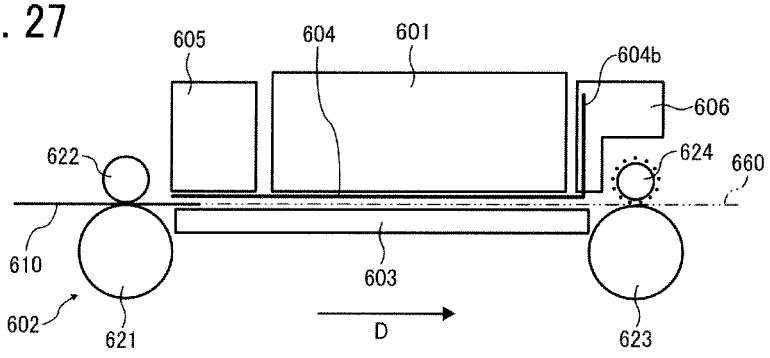

FIG. 28

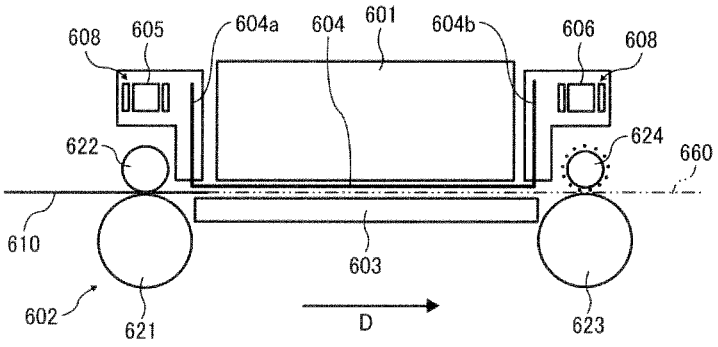
608
605
604a
604
601
604b
606
608
622
624
660
610
603
602
621
D
623

FIG. 29

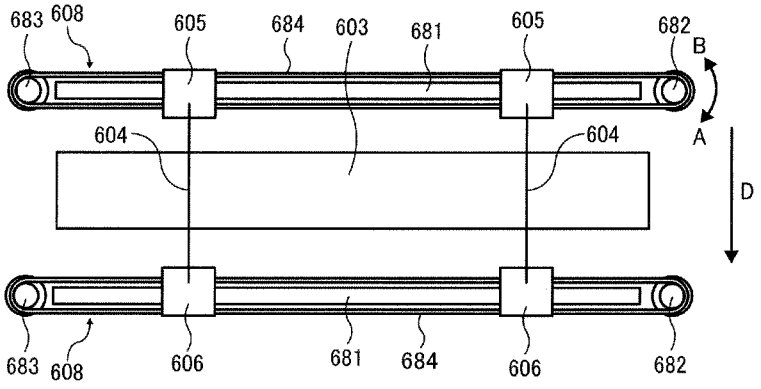
683
608
605
684
603
681
605
682
B
A
604
604
D
683
608
606
681
684
606
682

FIG. 30

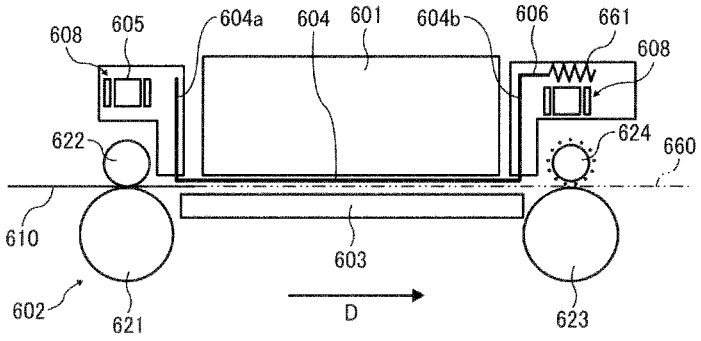
608
605
604a
604
601
604b
606
661
608
622
624
660
610
603
602
621
D
623

FIG. 31

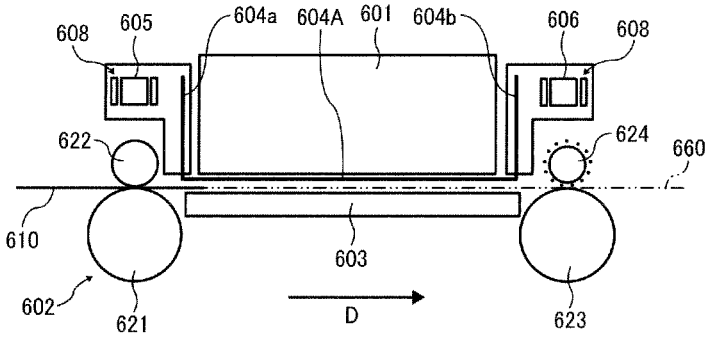
608
605
604a
604A
601
604b
606
608
622
624
660
610
603
602
621
D
623

FIG. 32

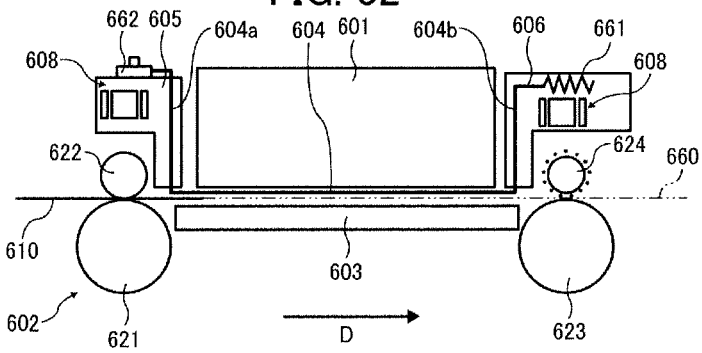
662
605
604a
604
601
604b
606
661
608
608
622
624
660
610
603
602
621
D
623

FIG. 33

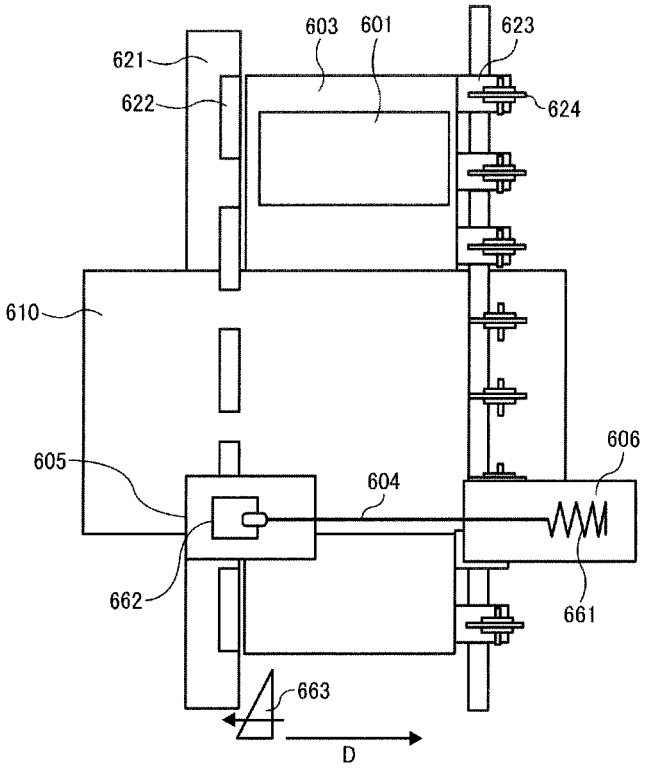
603
601
623
621
622
624
610
606
605
604
662
661
663
D

FIG. 34

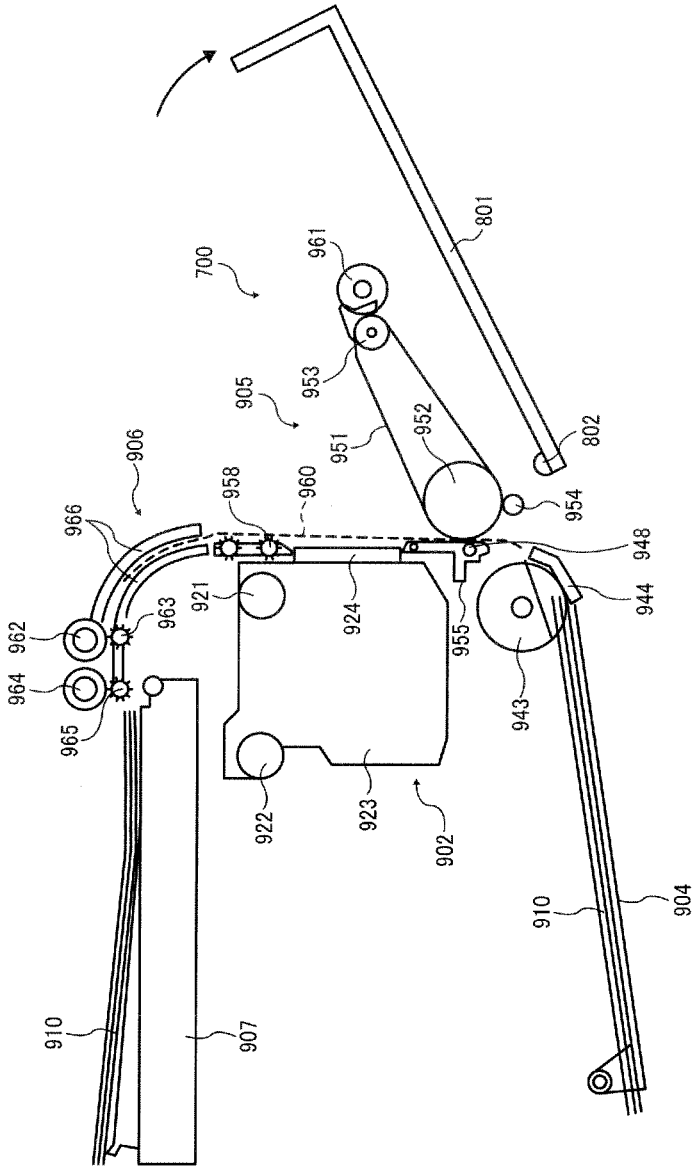
801
700
961
953
905
951
952
802
906
958
960
954
966
948
921
924
955
944
962
963
964
965
943
922
923
902
910
904
910
907

IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application is based on and claims priority pursuant to 35 U.S.C. §119(a) to Japanese Patent Application Nos. 2013-170042, filed on Aug. 20, 2013, 2013-170101, filed on Aug. 20, 2013, and 2014-115176, filed on Jun. 3, 2014, in the Japan Patent Office, the entire disclosure of each of which is hereby incorporated by reference herein.

BACKGROUND

1. Technical Field

Embodiments of this disclosure relate to an age forming apparatus.

2. Description of the Related Art

As an image forming apparatus such as a printer, a facsimile, a copier, a plotter, and a multifunctional device thereof, for example, an inkjet recording apparatus such as a liquid ejection recording type image forming apparatus is known which includes a recording head configured as a liquid ejection head (a droplet ejection head) ejecting an ink droplet. In such an image forming apparatus, for example, a configuration is known in which a recording medium is guided by a platen member while opposing an image forming unit and a guide member guiding the recording medium conveyed on the platen member and a sheet pressing member pressing a sheet are disposed so as to be movable in a direction perpendicular to a medium conveyance direction.

Particularly, in the case where an image is formed by the liquid ejection recording type, there is a need to maintain a narrow gap of, e.g., about 1 mm between the recording medium and a recording head configured as a liquid ejection head. For that reason, in the case where a regulation member (the guide member and the sheet pressing member) which presses the recording medium is disposed between the recording head and the platen member, there is a need to decrease the thickness of the regulation member.

BRIEF SUMMARY

In at least one embodiment of this disclosure, there is provided an image forming apparatus including an image forming unit, a conveyor, and a string-shaped regulation member. The image forming unit forms an image on a recording medium. The conveyor disposed opposing the image forming unit to convey the recording medium along a conveyance passage. The string-shaped regulation member is disposed between the image forming unit and the conveyance passage to regulate a distance between the recording medium and the image forming unit within a certain range.

In at least one embodiment of this disclosure, there is provided an image forming apparatus including an image forming unit, a conveyor, and a regulation member. The image forming unit forms an image on a recording medium. The conveyor is disposed opposing the image forming unit to convey the recording medium along a conveyance passage. The conveyor includes a pair of upstream-side rotary bodies at an upstream side of the image forming unit in a medium conveyance direction of the recording medium and a pair of downstream-side rotary bodies at a downstream side of the image forming unit in the medium conveyance direction. The regulation member is disposed between the image forming unit and the conveyance passage to regulate the recording medium. The regulation member includes an upstream-side support portion at an upstream side of the image forming unit in the medium conveyance direction to support the regulation member at the upstream side and a downstream-side support portion at a downstream side of the image forming unit in the medium conveyance direction to support the regulation member at the downstream side. The regulation member has a portion that is disposed between the pair of upstream-side rotary bodies and the image forming unit and extends in a vertical direction relative to the conveyance passage.

In at least one embodiment of this disclosure, there is provided an image forming apparatus including an image forming unit, a conveyor, and a regulation member. The image forming unit forms an image on a recording medium. The conveyor is disposed opposing the image forming unit to convey the recording medium along a conveyance passage. The conveyor includes a pair of upstream-side rotary bodies at an upstream side of the image forming unit in a medium conveyance direction of the recording medium and a pair of downstream-side rotary bodies at a downstream side of the image forming unit in the medium conveyance direction. The regulation member is disposed between the image forming unit and the conveyance passage to regulate the recording medium, the regulation member including an upstream-side support portion at an upstream side of the image forming unit in the medium conveyance direction to support the regulation member at the upstream side and a downstream-side support portion at a downstream side of the image forming unit in the medium conveyance direction to support the regulation member at the downstream side. The regulation member has a portion that is disposed between the pair of downstream-side rotary bodies and the image forming unit and extends in a vertical direction relative to the conveyance passage.

BRIEF DESCRIPTION OF THE DRAWINGS

The aforementioned and other aspects, features, and advantages of the present disclosure would be better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. **1** is a perspective view illustrating an example of an image forming apparatus according to an embodiment of this disclosure;

FIG. **2** is a side view illustrating the example according to an embodiment of this disclosure;

FIG. **3** is a perspective view illustrating a recording section (a printing section) according to a first embodiment of this disclosure;

FIG. **4** is a plan view illustrating the recording section according to an embodiment of this disclosure;

FIGS. **5**A and **5**B are perspective views illustrating a regulator according to the embodiment;

FIG. **6** is a side view illustrating the arrangement of a regulator of the embodiment;

FIG. **7** is a perspective view illustrating a recording section (a printing section) according to a second embodiment of this disclosure;

FIG. **8** is a plan view illustrating the recording section according to an embodiment of this disclosure;

FIGS. **9**A and **9**B perspective views illustrating a regulator of the embodiment;

FIGS. **10**A and **10**B are perspective views illustrating the movement range of the regulator according to an embodiment of this disclosure;

FIGS. **11**A and **11**B are perspective views illustrating a regulator according to a third embodiment of this disclosure;

FIG. **12** is a perspective view illustrating a regulator according to a fourth embodiment of this disclosure;

FIG. **13** is a perspective view illustrating a regulator according to a fifth embodiment of this disclosure;

FIG. **14** is a schematic plan view illustrating a sixth embodiment of this disclosure;

FIG. **15** is a perspective view illustrating an appearance of an image forming apparatus according to a seventh embodiment of this disclosure;

FIG. **16** is a perspective view illustrating a conveyance section of the image forming apparatus according to an embodiment of this disclosure;

FIG. **17** is a cross-sectional side view illustrating the conveyance section according to an embodiment of this disclosure;

FIG. **18** is a perspective view illustrating a platen member as a conveyance guide member according to an embodiment of this disclosure;

FIG. **19** is a plan view illustrating the platen member according to an embodiment of this disclosure;

FIG. **20** is a cross-sectional side view illustrating the platen member according to an embodiment of this disclosure;

FIG. **21** is a bottom view illustrating the platen member according to an embodiment of this disclosure;

FIG. **22** is a perspective view illustrating a guide member including a regulator according to an embodiment of this disclosure;

FIG. **23** is a side view illustrating the guide member according to an embodiment of this disclosure;

FIG. **24** is a perspective illustrating a platen member according to an eighth embodiment of this disclosure;

FIG. **25** is a side view illustrating a ninth embodiment of this disclosure;

FIG. **26** is a side view illustrating a tenth embodiment of this disclosure;

FIG. **27** is a side view illustrating an eleventh embodiment of this disclosure;

FIG. **28** is a side view illustrating a twelfth embodiment of this disclosure;

FIG. **29** is a plan view illustrating the twelfth embodiment;

FIG. **30** is a side view illustrating a thirteenth embodiment of this disclosure;

FIG. **31** is a side view illustrating a fourteenth embodiment of this disclosure;

FIG. **32** is a side view illustrating a fifteenth embodiment of this disclosure;

FIG. **33** is a plan view illustrating the fifteenth embodiment; and

FIG. **34** is a side view illustrating a sixteenth embodiment of this disclosure.

The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted.

DETAILED DESCRIPTION OF EMBODIMENTS

In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this patent specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that operate in a similar manner and achieve similar results.

Although the embodiments are described with technical limitations with reference to the attached drawings, such description is not intended to limit the scope of the disclosure and all of the components or elements described in the embodiments of this disclosure are not necessarily indispensable.

For example, in this disclosure, the term "sheet" used herein is not limited to a sheet of paper and includes anything such as OHP (overhead projector) sheet, cloth sheet, glass sheet, or substrate on which ink or other liquid droplets can be attached. In other words, the term "sheet" is used as a generic term including a recording medium, a recorded medium, a recording sheet, and a recording sheet of paper. The terms "image formation", "recording", "printing", "image recording" and "image printing" are used herein as synonyms for one another.

The term "image forming apparatus" refers to an apparatus that ejects liquid on a medium to form an image on the medium. The medium is made of, for example, paper, string, fiber, cloth, leather, metal, plastic, glass, timber, and ceramic. The term "image formation" includes providing not only meaningful images such as characters and figures but meaningless images such as patterns to the medium (in other words, the term "image formation" also includes only causing liquid droplets to land on the medium).

The term "ink" is not limited to "ink" in a narrow sense, unless specified, but is used as a generic term for any types of liquid usable as targets of image formation. For example, the term "ink" includes recording liquid, fixing solution, DNA sample, resist, pattern material, resin, and so on.

The term "image" used herein is not limited to a two-dimensional image and includes, for example, an image applied to a three dimensional object and a three dimensional object itself formed as a three-dimensionally molded image.

In addition, the ejecting direction of liquid is not limited to a vertically downward direction or a horizontal direction, and for example, may be an oblique direction or a vertically upward direction.

An image forming apparatus according to an embodiment of this disclosure is not limited to a serial-type image forming apparatus and, for example, may be a line-head-type image forming apparatus.

Referring now to the drawings, embodiments of the present disclosure are described below. In the drawings for explaining the following embodiments, the same reference codes are allocated to elements (members or components) having the same function or shape and redundant descriptions thereof are omitted below.

An image farming apparatus according to an embodiment of this disclosure will be described with reference to FIG. **1** and FIG. **2**. FIG. **1** is a perspective view illustrating the image forming apparatus, and FIG. **2** is a side view illustrating the image forming apparatus.

The image forming apparatus is a serial-type image forming apparatus. A carriage **104** is supported by a loadless-type guide assembly using a guide member **103** formed as a plate member stretched between right and left side plates so that the carriage **104** is movable in a direction (a main scanning direction) perpendicular to a medium conveyance direction (a sub-scanning direction) indicated by arrow D in FIG. **2**.

Further, the carriage **104** is equipped with a recording head **111** including a liquid ejection head as an image forming unit that ejects, for example, droplets of respective colors of yellow (Y), cyan (C), magenta (M), and black (K).

Ink (liquid) is supplied from an ink cartridge **113** as a liquid cartridge (a main tank) detachably attached to an apparatus body to the recording head **111** through a supply tube **114**.

Meanwhile, a sheet feed cassette **101** that loads sheets **210** (see FIG. **4** below) as a recording medium is mounted on a

bottom side of the apparatus body. The sheets **210** inside the sheet feed cassette **101** are delivered one by one by a sheet feed roller **143**.

The sheet **210** which is fed from the sheet feed cassette **101** is sent to a gap between a conveyance roller **151** and a pressing roller **152** through a relay roller **144** and a conveyance guide plate **145**. The conveyance roller **151** and the pressing roller **152** are a pair of rotary bodies disposed at the upstream side of the image forming unit in the medium conveyance direction D.

Then, the sheet is intermittently conveyed by a conveyance force generated by the conveyance roller **151** and the pressing roller **152** while being guided by a rib **153***a* of a platen member **153** as a conveyance guide member disposed to face the image forming unit.

At this time, when the recording head **111** is driven in response to an image signal while the carriage **104** is moved, an ink droplet is ejected to the stopped sheet **210** to perform a recording operation for one line, and the sheet **210** is conveyed by a predetermined amount to perform a recording operation for the next line. The recording operation ends when a recording end signal or a signal indicating the state where a tail end of the sheet **210** reaches a recording area is obtained.

Sheet discharge rollers **154** and spur rollers **155** are disposed at the downstream side of the platen member **153**, and discharge the sheet **210** having an image formed thereon onto a sheet discharge tray **102**. The sheet discharge rollers **154** and the spur rollers **155** are pairs of rotary bodies disposed at the downstream side of the image forming unit in the medium conveyance direction D.

Next, a first embodiment of this disclosure applied to the image forming apparatus will be described with reference to FIGS. **3** and **4**. FIG. **3** is a perspective view illustrating a recording section (a printing section) of the first embodiment, and FIG. **4** is a plan view illustrating the first embodiment.

As described above, a platen member **153** forms a conveyance passage **160** through which the sheet **210** is conveyed.

Two regulators **201** which regulate the uplift of the sheet **210** are provided above the platen member **153** in the main scanning direction (the carriage moving direction).

The regulator **201** includes a regulation member **204** which is formed as a string-shaped member regulating the distance between the sheet **210** and the image forming unit (the recording head **111**) within a uniform range and holding members **205** and **206** which hold the regulation member **204**.

The holding members **205** and **206** are guide members which support the regulation member **204**, and also serve as fixation portions which hold the regulation member **204** while fixing both ends thereof.

The regulation member **204** is a flexible string-shaped member (here, a "string"), and is held by two holding members **205** and **206** while a tension is applied thereto.

The platen member **153** includes a plurality of ribs **153***a* which guides the sheet **210** in a contact state, and the regulation member **204** is held at a position higher than the ribs **153***a*.

Further, the regulator **201** is held at a position which does not cause an interference with the carriage **104** and the recording head **111**, and hence the regulator **201**, the carriage **104**, and the recording head **111** do not contact each other even when the carriage **104** scans the upside of the platen member **153** in order to perform a print operation.

Here, the holding members **205** and **206** of the regulator **201** are held so as to be movable in a direction parallel to the scan direction of the carriage **104** by a guide rail **281**. Then, the holding members are moved by a motor through a timing belt **284** wound around pulleys **282** and **283**.

The timing belt **284** is provided in each of the upstream side and the downstream side of the platen member **153** in the medium conveyance direction, the upstream-side timing belt **284** transmits a power to the upstream-side holding member **205**, and the downstream-side timing belt **284** transmits a power to the downstream-side holding member **206**.

The operations of the upstream-side timing belt **284** and the downstream-side timing belt **284** are synchronized with each other by a different timing belt, and hence the upstream-side holding member **205** and the downstream-side holding member **206** move in a synchronization state.

In this way, when the regulator **201** including the regulation member **204** moves in the main scanning direction, the upstream-side and downstream-side holding members **205** and **206** are operated in a synchronization state, and hence the regulator may move without any inclination in the scan direction of the carriage **104**.

Further, in two holding members **205** connected to the upstream-side timing belt **284**, the timing belt **284** having a loop shape is fixed and held by a fixation portion **288** at a different surface. Similarly, in two holding members **206** connected to the downstream-side timing belt **284**, the timing belt **284** having a loop shape is fixed and held by the fixation portion **288** at a different surface.

Accordingly, when the timing belt **284** rotates, two regulators **201** are respectively operated in the opposite directions in the scan direction of the carriage **104**. Thus, two regulators **201** move so as to be symmetrical to each other about the center in the width direction of the platen member **153** at all times.

When a print operation is performed, a controller reads the size of the sheet **210** in print information transmitted from a host, and moves the positions of the regulators **201** so as to match the size of the sheet **210** in the width direction.

The regulators **201** are moved so as to be located inside both ends in the width direction perpendicular to the medium conveyance direction of the sheet **210** conveyed along the platen member **153**. Thus, when the sheet **210** is conveyed along the platen member **153**, the end of the sheet **210** is nipped between the platen member **153** and the regulation members **204** of the regulators **201**.

The regulation member **204** of the regulator **201** may suppress the uplift of the end of the sheet **210**. That is, for example, even when the sheet **210** of which the end is easily lifted upward due to the damage and the bending of the sheet **210** is conveyed, the sheet is regulated at a position where the sheet does not contact the carriage **104** and the recording head **111** due to the regulation member **204** of the regulator **201**. Thus, it is possible to prevent a failure (for example, a friction, a jam, or the like) caused by the contact of the sheet **210** with respect to the carriage **104** and the recording head Ill.

Further, an area where the regulation member **204** is located between the sheet **210** and the recording head **111** becomes an area where a print operation may not be performed on the sheet **210**.

Therefore, since the thin string-shaped member is used as the regulation member **204**, the end outside the printable area of the sheet **210** may be suppressed, and hence the uplift of the sheet may be reduced without decreasing the size of the printable area.

Further, since the regulation member **204** is formed as the string-shaped member, the regulation member **204** is bent by the contact with respect to the carriage **104**, and hence the damage thereof may be prevented compared to a thin and flexible member such as Mylar having a uniform width.

Further, in a flat member such as mylar, when a deviation occurs in the width direction of the fixation member (the holding member) at the downstream side and the upstream side in the medium conveyance direction, the regulation member is twisted, and the regulation member is lifted upward. For that reason, there is a need to accurately synchronize the movement of the fixation members at the downstream side and the upstream side in the medium conveyance direction.

On the contrary, since the regulation member **204** is the string-shaped member, the regulation member **204** is not twisted even when a slight deviation occurs in the synchronization of the fixation member (the holding member). For this reason, there is no need to precisely synchronize the movement of the fixation members, and hence the fixation member moves easily.

Next, the regulator of this embodiment will be described in detail with reference to FIGS. **5**A and **5**B. FIGS. **5**A and **5**B are perspective views illustrating the regulator, where FIG. **5**A is a perspective view including the holding member, and FIG. **5**B is a perspective view illustrating a laid passage of the regulation member except for the holding member. FIGS. **5**A and **5**B are perspective views illustrating the regulator.

A leaf spring **211** is provided inside the upstream-side holding member **205**, and one end of the regulation member **204** is held by the holding member **205** through the leaf spring **211**. One end of the regulation member **204** is formed in a loop shape, and is caught and held by a notch formed in the leaf spring **211**.

Further, the downstream-side holding member **206** is provided with a fixation member **212**, and the other end of the regulation member **204** is held by the holding member **206** through the fixation member **212**. The other end of the regulation member **204** is held in a manner such that the loop-shaped end is caught by a pawl formed in the fixation member **212**.

Here, since one end of the regulation member **204** is held by the holding member **205** through the leaf spring **211**, the regulation member **204** is held while a tension is applied thereto. For this reason, the regulation member **204** is formed of a flexible material, but is held in a tension application state, so that the regulation member is held in a shape along the shapes of the holding members **205** and **206** as illustrated in FIG. **13**A.

Further, since one end of the regulation member **204** is held by the leaf spring **211**, a certain degree of deformation of the regulation member **204** is allowed.

Here, for example, when the sheet **210** is stopped on the platen member **153** due to a certain reason during the print operation, a user needs to remove the sheet **210** on the platen member **153**. At this time, since the regulation member **204** is formed of a flexible material as described above, a certain degree of deformation is allowed. During such clearance, the sheet **210** stopped on the platen member **153** may be removed without damaging the regulation member **204** or the holding members **205** and **206**.

Next, the arrangement of the regulator **201** of this embodiment will be described with reference to FIG. **6**. FIG. **6** is a side view illustrating the arrangement.

The conveyance roller **151** and the pressing roller **152** which sends the sheet **210** onto the platen member **153** are provided at the upstream side of the platen member **153** in the medium conveyance direction D.

The sheet discharge rollers **154** and the spur rollers **155** which send the sheet **210** delivered from the platen member **153** to the sheet discharge tray **102** are provided at the downstream side of the platen member **153** in the medium conveyance direction D.

Here, the pressing roller **152** is held by the apparatus body through a pressing plate **221**. Further, the spur rollers **155** is held by the apparatus body through a spur holder **222**.

Then, both ends of the regulation member **204** are respectively held by the upstream-side holding member **205** provided above the pressing plate **221** and the downstream-side holding member **206** provided above the spur holder **222**.

Thus, the holding members **205** and **206** as the guide members are located near the recording head **111** in relation to the position of the regulation member between the recording head **111** and the recording medium conveyance passage **160**. Further, both ends of the regulation member **204** are disposed through the upside of the pressing roller **152** and the spur rollers **155**, that is, the opposite side to the conveyance passage **160**.

Here, the upstream-side holding member **205** is movably held by the guide rail **281** held by the apparatus body. The downstream-side holding member **206** is movably held by the guide rail **281** (the rail) provided in the spur holder **222** held by the apparatus body.

The front ends of the holding members **205** and **206** respectively extend from the upper surfaces of the pressing plate **221** and the spur holder **222** to the vicinity of the platen member **153** so as to cover the end near the platen member **153**.

Then, the flexible regulation member **204** is disposed so as to pass through a gap between the recording head **111** and the platen member **153** on the platen member **153** along the shapes of the holding members **205** and **206**.

When the regulation member **204** and the holding members **205** and **206** are formed in this way, the regulation member **204** and the holding members **205** and **206** are movable to an arbitrary position in the main scanning direction. Further, since these members are disposed at a position where any interference with the recording head **111** does not occur, the operation of the recording head **111** is not disturbed during the print operation.

Further, only the regulation member **204** is disposed between the platen member **153** and the recording head **111**. However, since the regulation member **204** is formed as the string-shaped member, the thickness may be decreased compared to, for example, a regulation member formed as a thin plate such as sheet metal. Accordingly, since an increase in distance between the platen member and the recording head may be suppressed due to the addition of the regulation member, and hence a satisfactory image may be obtained by the liquid ejection recording type.

Furthermore, the holding members **205** and **206** as the guide members are located near the recording head **111** in relation to the position of the regulation member **204** between the recording head **111** as the image forming unit and the recording medium conveyance passage **160**. Thus, the sheet **210** may be conveyed along the platen member **153** without causing any interference when the sheet **210** is conveyed along the platen member **153**.

Next, a second embodiment of this disclosure will be described with reference to FIGS. **7** and **8**. FIG. **7** is a perspective view illustrating a recording section (a printing section) of the second embodiment, and FIG. **8** is a plan view illustrating the recording section.

In this embodiment, both ends of the regulation member **204** of the regulator **201** are respectively fixed and held by holding portions (fixation portions) **307** and **308** which are provided in the pressing plate **221** and the spur holder **222** and

are different from guide members **305** and **306**, and the halfway portions thereof are held and guided by the guide members **305** and **306**.

Here, the guide members **305** and **306** of the regulator **201** are held so as to be movable in a direction parallel to the scan direction of the carriage **104** by the guide rail **281** similarly to the holding members **205** and **206** of the first embodiment. Then, the guide members are moved by a motor through the timing belt **284** wound around the pulleys **282** and **283**.

The timing belt **284** is provided in each of the upstream side and the downstream side of the platen member **153** in the medium conveyance direction D, the upstream-side timing belt **284** transmits a power to the upstream-side guide member **305**, and the downstream-side timing belt **284** transmits a power to the downstream-side guide member **306**.

The operations of the upstream-side timing belt **284** and the downstream-side timing belt **284** are synchronized with each other by a different timing belt, and hence the upstream-side guide member **305** and the downstream-side guide member **306** move in a synchronization state.

In this way, when the regulator **201** including the regulation member **204** moves in the main scanning direction, the upstream-side and downstream-side guide members **305** and **306** are operated in a synchronization state, and hence the regulator may move without any inclination in the scan direction of the carriage **104**.

Further, in two guide members **305** connected to the upstream-side timing belt **284**, the timing belt **284** having a loop shape is fixed and held by a fixation portion **288** at a different surface. Similarly, in two guide members **306** connected to the downstream-side timing belt **284**, the timing belt **284** having a loop shape is fixed and held by the fixation portion **288** at a different surface.

Accordingly, when the timing belt **284** rotates, two regulators **201** are respectively operated in the opposite directions in the scan direction of the carriage **104**. Thus, two regulators **201** move so as to be symmetrical to each other about the center in the width direction of the platen member **153** at all times.

When a print operation is performed, a controller reads the size of the sheet **210** in print information transmitted from a host, and moves the positions of the regulators **201** so as to match the size of the sheet **210** in the width direction.

Next, the regulator **201** of this embodiment will be described in detail with reference to FIGS. **9**A and **9**B. FIGS. **9**A and **9**B are perspective views illustrating the regulator, where FIG. **9**A is a perspective view illustrating the guide member, and FIG. **9**B is a perspective view illustrating a laid passage of the regulation member except for the guide member.

One end of the regulation member **204** is laid in a direction perpendicular to the medium conveyance direction D while the halfway portion thereof is supported by the upstream-side guide member **305** in the medium conveyance direction D, and the loop-shaped portion formed at the end is caught and held by a projection **307** formed in the pressing plate **221**.

The other end of the regulation member **204** is laid in a direction perpendicular to the medium conveyance direction D while the halfway portion thereof is supported by the downstream-side guide member **306** in the medium conveyance direction D, and a loop-shaped portion formed in the end is caught and held by a fixation portion **308** formed in the spur holder **222**.

In this way, since the end of the regulation member **204** is held by a member forming the conveyance passage **160** such as a pressing plate or a spur holder, it is possible to decrease the number of components used for the fixing operation.

Next, regulator movement range will be described with reference to FIGS. **10**A and **10**B. FIGS. **10**A and **10**B are perspective views illustrating the regulator movement range.

The regulation member **204** of the regulator **201** and the guide members **305** and **306** may handle the maximum-width sheet while moving to a position illustrated in FIG. **10**A, and may handle the minimum-width sheet while moving to a position illustrated in FIG. **10**B.

Further, when the guide members **305** and **306** move due to the sheet size, an area of the regulation member **204** facing, a printing face also moves. For this reason, a contamination caused by an ink mist does is dispersed without concentrating on a partial position compared to the case where the regulation member **204** is fixed to the guide member, and hence the product life of the regulation member **204** may be extended.

Next, a third embodiment of this disclosure will be described with reference to FIGS. **11**A and **11**B. FIGS. **11**A and **11**B are perspective views illustrating a regulator of the third embodiment, where FIG. **11**A is a perspective view including a guide member, and FIG. **11**B is a perspective view illustrating a laid passage of a regulation member except for the guide member.

In this embodiment, the end of the regulation member **204** fixed to the spur holder **222** is fixed by an elastic member **310** such as a leaf spring. Furthermore, the end fixed to the pressing plate **221** may be also fixed by an elastic member to a position other than the spur holder **222** or the position of the spur holder **222**.

In this way, since at least one end of the regulation member **204** is fixed by the elastic member, the regulation member **204** may be deformed by a certain degree.

Thus, it is possible to reduce the damage of the regulation member **204** during the clearance of the jam as in the first embodiment.

For example, when the sheet **210** is stopped on the platen member **153** due to a certain reason during the print operation, the user needs to remove the sheet **210** on the platen member **153**. At this time, since the regulation member **204** is formed of a flexible material and a certain degree of deformation thereof is allowed, it is possible to remove the sheet **210** stopped on the platen member **153** without damaging the regulation member **204** or the guide members **305** and **306** during such clearance.

Next, a fourth embodiment of this disclosure will be described with reference to FIG. **12**. FIG. **12** is a perspective view illustrating a regulator of the fourth embodiment.

In this embodiment, curved portions **311** and **312** as laid portions for switching the direction of the regulation member **204** of the guide members **305** and **306** from the medium conveyance direction D to a direction intersecting the medium conveyance direction D are formed in an obtuse angle shape (or a curved surface shape).

Thus, the abrasion of the regulation member **204** or the guide members **305** and **306** may be reduced.

Next, a fifth embodiment of this disclosure will be described with reference to FIG. **13**. FIG. **13** is a perspective view illustrating a regulator of the fifth embodiment.

In this embodiment, a wiping member **313** which wipes off the circumferential surface of the regulation member **204** is disposed in the curved portions **311** and **312** which switch the direction of the regulation member **204** of the guide members **305** and **306** from the medium conveyance direction D to a direction intersecting the medium conveyance direction D.

That is, in the case of the liquid ejection type image forming apparatus, a mist or the like easily adheres to the regulation member **204**. Then, when the sheet **210** contacts the

regulation member **204** while the mist adheres to the regulation member, the image quality is degraded.

Here, in this embodiment, since both ends of the regulation member **204** are fixed to a member different from the guide members **305** and **306**, the surface of the regulation member **204** is wiped off by the wiping member **313** so as to be cleaned by the movement of the guide members **305** and **306**. Thus, it is possible to remove a contamination caused by the adherence of the mist, and hence to prevent degradation in print quality.

Next, a sixth embodiment of this disclosure will be described. FIG. **14** is a schematic plan view illustrating the sixth embodiment.

In this embodiment, one end of the regulation member **204** of the regulator **201** is held by a holding portion **410** of the pressing plate **221**. Then, the halfway portion of the regulation member **204** is supported by the guide member **405** so that the direction of the regulation member is switched from the main scanning direction to the medium conveyance direction D, and the halfway portion thereof is supported by the guide member **406** so that the direction thereof is switched from the medium conveyance direction D to the main scanning direction.

Then, the other end of the regulation member **204** of the regulator **201** is held by a holding portion **411** provided in an area other than the main scanning area of the carriage **104**.

Here, the holding portion **411** is formed of a reel member around which the regulation member **204** is wound by a desired amount. When the reel member is rotated in reverse, the regulation member **204** is loosened.

Thus, when a jam or the like occurs, the jam may be cleared after the regulation member **204** is loosened.

That is, when the regulation member **204** is retracted in the event of the jam, there is a concern that the regulation member **204** may be damaged while being caught by the jammed sheet. Therefore, when the regulation member **204** is loosened in the event of the jam, the damage of the regulation member **204** may be prevented.

Further, in this embodiment, since the length of the regulation member **204** may be changed, the regulation member **204** may be disposed in an inclined state, for example, in a manner such that the guide member **405** is moved to the center side and the guide member **406** is moved to the end side in the main scanning direction. However, in this case, the upstream-side guide member **405** and the downstream-side guide member **406** are adapted to be separately driven.

Next, a seventh embodiment of this disclosure will be described with reference to FIGS. **15** to **23**. FIG. **15** is a perspective view illustrating an appearance of an image forming apparatus according to the seventh embodiment, FIG. **16** is a perspective view illustrating a conveyance section of the image forming apparatus, FIG. **17** is a cross-sectional side view illustrating the conveyance section, FIG. **18** is a perspective view illustrating a platen member as a conveyance guide member, FIG. **19** is a plan view illustrating a platen member, FIG. **20** is a cross-sectional side view illustrating the platen member, and FIG. **21** is a bottom view illustrating the platen member.

In the image forming apparatus, the carriage **104** equipped with the recording head **111** as the image forming unit and a conveyance assembly **550** as a conveyor conveying the sheet **210** while opposing the recording head **111** are disposed inside the apparatus body **100**.

Then, similarly to the image forming apparatus, an image is formed on the sheet **210** by the recording head **111** while the sheet **210** fed from the sheet feed cassette **101** is conveyed by the conveyance assembly **550**, and the recording medium having an image formed thereon is discharged to the sheet discharge tray **102**.

The conveyance assembly **550** includes a conveyance roller **551**, a pressing roller **552**, a platen member **553** which serves as a conveyance guide member guiding the sheet **210** while facing the recording head **111**, a sheet discharge roller **554**, and a spur **555**. The platen member **553** includes a plurality of ribs **553***a* to guide the sheet **210**.

Then, regulators **501** including regulation members **504** are formed as string-shaped members as in the regulation member **204** disposed between the platen member **553** and the recording head **111** as the image forming unit.

The regulator **501** includes a guide member **502** which supports the regulation member **504** at the upstream side and the downstream side of the image forming unit in the medium conveyance direction D, and the guide member **502** is provided in the platen member **553** so as to be movable in a direction perpendicular to the medium conveyance direction D.

Here, the guide member **502** includes an upstream-side holding portion **505** which supports the regulation member **504** at the upstream side of the image forming unit in the medium conveyance direction D, a downstream-side holding portion **506** which supports the regulation member **504** at the downstream side of the image forming unit in the medium conveyance direction D, and a connecting portion **507** which connects the upstream-side holding portion **505** and the downstream-side holding portion **506** to each other.

Then, the guide member **502** includes a moving member **503** which is provided at the opposite side to the recording medium guide side of the platen member **553** so as to be movable in a direction perpendicular to the medium conveyance direction D.

The moving member **503** is movably held by a platen rail **556** fixed to the bottom surfaces (the rear surface in the conveyance passage **160**) of the platen member **553** and the platen member **553**. Furthermore, the platen member **553** and the platen rail **556** may be integrally formed with each other by a resin or the like. In this case, the number of components may be decreased.

Then, the connecting portion **507** of the guide member **502** is attached to the moving member **503**.

As a driving assembly which moves the moving member **503** in the main scanning direction, the bottom surface of the platen rail **556** is provided with pulleys **523** and **524** and a timing belt **525** wound around the pulleys **523** and **524**.

Then, the moving members **503** of the regulator **501** are fixed to the different surfaces of the timing belt **525** by belt clamps **526** and **527**, and the right and left moving members **503** and **503** are operated in the rotation direction of the single timing belt **525** so as to move in approaching and separation directions.

Furthermore, the rotation of the timing belt **525** is performed by a driving motor through a different timing belt or a gear transmission assembly. Further, the timing belt may be replaced by a different belt such as a flat belt or a ring belt, and the belt type is not limited to the timing belt.

Further, the moving member **503** is provided with a convex portion **508**, and the convex portion **508** is detected by an apparatus body side sensor **530**, so that the position of the moving member **503** (the position of the regulation member **504**) is detected.

Here, the guide member **502** will be described with reference to FIGS. **22** and **23**. FIG. **22** is a perspective view illustrating a guide member including a regulator, and FIG. **23** is a side view illustrating the guide member.

The guide member **502** includes the upstream-side holding portion **505** and the downstream-side holding portion **506** which are uprightly formed in the end of the connecting portion **507** having a C-shape in a plan view and are curved in the main scanning direction.

Then, the upstream-side holding portion **505** is provided with a protrusion **510** which protrudes toward the platen member **553** so as to determine the height of the regulation member **504**. The protrusion **510** includes continuous tapered portions **510***a* and **510***b*.

That is, the protrusion **510** which protrudes toward the platen member **553** becomes a portion which first contacts the sheet **210** compared to the regulation member **504** when the sheet **210** is lifted upward. Therefore, since the protrusion **510** is provided with the tapered portions **510***a* and **510***b*, it is possible to prevent the recording medium from being caught during the conveying operation thereof.

Further, the upstream-side end of the regulation member **504** is fixed and held by a cutout portion **511***a* provided in the upstream-side holding portion **505**, and the downstream-side end thereof is fixed and held by a cutout portion **511***b* provided in the connecting portion **507** in the vicinity of the upright portion of the downstream-side holding portion **506**.

Furthermore, the tapered portions **510***a* and **510***b* are integrally formed with the upstream-side holding portion **505**, but may be formed separately from each other. Further, the shape of preventing the caught state is not limited to the shape of FIG. **23**.

In this way, since the guide member **502** that supports the regulation member **504** at the upstream side and the downstream side in the medium conveyance direction D is provided in the conveyance guide member (the platen member **553**) so as to be movable in a direction perpendicular to the medium conveyance direction D, it is possible to reduce the positional deviation of the regulation member at the upstream side and the downstream side compared to the configuration in which the upstream-side and downstream-side guide members are separately moved as in the above-described embodiments.

That is, since the guide members are separately provided at the upstream side and the downstream side, a positional deviation may occur in the main scanning direction at the upstream side and the downstream side of the regulation member. For that reason, there is a need to take a large superimposed width (margin) of the regulation member with respect to the end of the recording medium in the width direction in order to prevent the deviation of the regulation member from the end of the recording medium or the adherence of the droplet with respect to the regulation member.

As a result, the printable area of the recording medium decreases. Further, since the driving assembly of the guide member is provided in at least one of the gap between the conveyance roller and the carriage and the gap between the carriage and the sheet discharge roller, the size of the apparatus body increases. Moreover, since the guide member, the guide rail, the driving unit, and the like are respectively provided at the upstream side and the downstream side, the apparatus configuration becomes complicated, and hence the number of components increases.

On the contrary, when one guide member supports (holds) the upstream side and the downstream side of the regulation member and is movable in the main scanning direction as in this embodiment, it is possible to reduce a failure caused when the upstream side and the downstream side are supported by separate guide members.

Next, an eighth embodiment of this disclosure will be described with reference to FIG. **24**. FIG. **24** is a perspective view illustrating a platen member according to the eighth embodiment.

In this embodiment, an abutting portion **541** is provided which causes the moving member **503** to abut against the platen member **553**.

Then, the reference position of the regulation member **504** is detected by detecting a change in motor load, which occurs when the moving members **503** are respectively moved in the arrow direction (by a belt moving in a single direction) to abut against the abutting portion **541**, through a current value or the like.

Thus, it is possible to omit a sensor for detecting the reference position of the regulation member **504**.

Next, an example of a control in the use/non-use state of the regulation member **504** will be described.

For example, when the uplift amount at the end of the recording medium is small at the single face printing and the double face printing with a small ejection amount, the regulation member is not used. Further, even when the regulation member is used at the double face printing, it is possible to decrease the standby time caused by the positioning of the regulation member by the configuration in which the medium width direction result in the case of a print operation performed on a first surface is stored and the regulation member is moved for a medium reversing time up to a print operation performed on a second surface.

Hereinafter, a ninth embodiment of this disclosure will be described with reference to FIG. **25**. FIG. **25** is a side view illustrating the ninth embodiment.

An image forming apparatus includes a recording head **601** which is configured as a liquid ejection head such as an image forming unit forming an image on a recording medium (hereinafter, referred to as a "sheet") **610** and a conveyor **602** which opposes the recording head **601** as the image forming unit and conveys the sheet **610**.

The conveyor **602** includes a conveyance roller **621** and a pressing roller **622** which serve as a pair of upstream-side rotary bodies disposed at the upstream side of the recording head **601** in the medium conveyance direction D and includes a sheet discharge roller **623** and a spur roller **624** which serve as a pair of downstream-side rotary bodies disposed at the downstream side of the recording head **601** in the medium conveyance direction.

A platen member **603** which opposes the recording head **601** and guides the sheet **610** is disposed between the pair of the conveyance roller **621** and the pressing roller **622** and the pair of the sheet discharge roller **623** and the spur roller **624**. The guide surface side of the platen member **603** forms a conveyance passage **660** for the sheet **610**.

Then, a regulation member **604** which presses the sheet **610** (to regulate the uplift) is disposed between the recording head **601** and the platen member **603** forming the conveyance passage **660** for the sheet **610**. The regulation member **604** is formed of for example, a string-shaped member such as a silk gut line and a thin-layer member such as a PET film.

An upstream-side support portion **605** which supports the regulation member **604** at the upstream side of the recording head **601** in the medium conveyance direction and a downstream-side support portion **606** which supports the regulation member **604** at the downstream side of the recording head **601** in the medium conveyance direction are provided.

The regulation member **604** includes a portion **604***a* which approaches to (extends relative to) the conveyance passage **660** for the sheet **610** in the vertical direction and is provided

between the recording head **601** and the pair of the conveyance roller **621** and the pressing roller **622** as the pair of upstream-side rotary bodies.

Further, the regulation member **604** includes a portion **604***b* which moves away from (extends relative to) the recording medium conveyance passage **660** in the vertical direction and is provided between the recording head **601** and the pair of the sheet discharge roller **623** and the spur roller **624** as the pair of downstream-side rotary bodies.

Furthermore, in this disclosure, the language that the portion approaches to the recording medium conveyance passage **660** in the vertical direction indicates that the portion approaches (extends) from a position opposing the conveyance passage **660** toward the conveyance passage **660**, and does not necessarily means that the portion approaches to the conveyance passage **660** in the exactly vertical direction. For example, in this embodiment, the "portion which approaches to the conveyance passage **660** in the vertical direction" may be the portion which is directed from the upside of the conveyance passage **660** toward the downside thereof, and is not limited to a portion which is disposed in the vertical direction with respect to the conveyance passage **660**. Then, a portion which is disposed in an inclined direction with respect to the conveyance passage **660** is also included. Further, the same applies to the language that the portion moves away from the conveyance passage **660**.

Then, the regulation member **604** in the range from the lowest end of the portion **604***a* to the lowest end of the portion **604***h* is disposed so as to pass between the recording head **601** and the platen member **603**.

In this way, since both ends of the regulation member **604** in the medium conveyance direction are respectively supported by the upstream-side support portion **605** and the downstream-side support portion **606**, the regulation member **604** may be stably and reliably held at the necessary position between the recording head **601** and the platen member **603**.

Thus, since the regulation member **604** may be formed as a thin member or a string-shaped member, the uplift of the sheet from the conveyance passage **660** is reduced, the gap between the image forming unit and the sheet is narrowed, and hence a narrow gap may be ensured between the image forming unit and the sheet.

Here, as described above, the regulation member **604** includes the portion **604***a* which approaches to the recording medium conveyance passage **660** in the vertical direction and is provided between the recording head **601** and the pair of the conveyance roller **621** and the pressing roller **622**. Thus, there is no need to widen the gap between the recording head **601** and the pair of the conveyance roller **621** and the pressing roller **622** in order to dispose the regulation member **604**, and hence the apparatus may be decreased in size.

Further, the regulation member **604** includes the portion **604***b* which moves away from the recording medium conveyance passage **660** in the vertical direction and is provided between the recording head **601** and the pair of the sheet discharge roller **623** and the spur roller **624**. Thus, there is no need to widen the gap between the recording head **601** and the pair of the sheet discharge roller **623** and the spur roller **624** in order to dispose the regulation member **604**, and hence the apparatus may be decreased in size.

A tenth embodiment of this disclosure will be described with reference to FIG. **26**. FIG. **26** is a side view illustrating the tenth embodiment.

This embodiment is different from the ninth embodiment in that the regulation member **604** includes the portion **604***a* which approaches to the recording medium conveyance passage **660** in the vertical direction and is provided between the recording head **601** and the pair of the conveyance roller **621** and the pressing roller **622**, but does not include a downstream-side portion **604***b* which moves away from the recording medium conveyance passage **660** in the vertical direction.

Even in such a configuration, there is no need to widen the gap between the recording head **601** and the pair of the conveyance roller **62***l* and the pressing roller **622** in order to dispose the regulation member **604**, and hence the apparatus may be decreased in size.

An eleventh embodiment of this disclosure will be described with reference to FIG. **27**. FIG. **27** is a side view illustrating the eleventh embodiment.

This embodiment is different from the ninth embodiment in that the regulation member **604** includes the portion **604***b* which moves away from the recording medium conveyance passage **660** in the vertical direction and is provided between the recording head **601** and the pair of the sheet discharge roller **623** and the spur roller **624**, but does not include an upstream-side portion **604***a* which approaches to the recording medium conveyance passage **660** in the vertical direction.

Even in such a configuration, there is no need to widen the gap between the recording head **601** and the pair of the sheet discharge roller **623** and the spur roller **624** in order to dispose the regulation member **604**, and hence the apparatus may be decreased in size.

Next, a twelfth embodiment of his disclosure will be described with reference to FIGS. **28** and **29**. FIG. **28** is a side view illustrating the twelfth embodiment, and FIG. **29** is a plan view illustrating the twelfth embodiment.

In this embodiment, a driving assembly **608** as a driving unit is provided which moves the upstream-side support portion **605** and the downstream-side support portion **606** in a direction perpendicular to the medium conveyance direction.

The driving assembly **608** includes a guide rail **681** which guides the upstream-side support portion **605** and the downstream-side support portion **606**, a timing belt **684** which is wound around pulleys **682** and **683** and, a driving source which rotates the pulley **682**, and the upstream-side support portion **605** or the downstream-side support portion **606** is connected to the timing belt **684**.

Here, each of the upstream-side support portion **605** and the downstream-side support portion **606** is disposed at two positions so as to regulate the end of the sheet **610** in the width direction (the main scanning direction). Then, two upstream-side support portions **605** are connected to different surfaces of the loop-shaped timing belt **684**. Similarly, two upstream-side support portions **605** are connected to different surfaces of the loop-shaped timing belt **684**.

Thus, two upstream-side support portions **605** move in a direction moving away from each other by the rotation of the timing belt **684** in one direction (for example, the direction indicated by arrow A). Further, two upstream-side support portions **605** move in a direction moving close to each other by the rotation of the timing belt **684** in the other direction (for example, the direction indicated by arrow B). Further, the same applies to the movement of two downstream-side support portions **606**.

With such a configuration, when the upstream-side support portion **605** and the downstream-side support portion **606** are moved by the driving assembly **608**, the regulation members **604** may be moved to a necessary position in response to the width of the sheet **610**.

Furthermore, the driving assembly may be a feed screw or a ball screw. When such a screw is used, the rotation of the support portions **605** and **606** is regulated. Further, a driving source such as a linear motor that directly moves the support portions **605** and **606** may be also used.

Here, a clearance of a sheet jam will be described.

As described above, when the sheet jam occurs in the state where the regulation member **604** is disposed between the conveyance passage **660** and the recording head **601**, the regulation member may disturb (cause an interference) when a user performs a jam clearance of removing the sheet **610** causing the jam in that the sheet **610** exists between the regulation member **604** and the platen member **603**. Further, there is a concern that the regulation member **604** may be damaged.

Therefore, when the sheet jam is detected due to the occurrence of the sheet jam, e recording head **601** is moved in a direction moving away from the sheet **610** or the direction opposite to the direction when the jam does not occur. However, the regulation member **604** is also moved in the same direction as the recording head **601**.

Thus, it is possible to prevent the regulation member **604** from disturbing the jam clearance.

Furthermore, the jam may be detected by a change in voltage value of the moving unit moving the recording head **601**, a change in speed of the recording head **601**, or the optical sensor.

Next, a thirteenth embodiment of this disclosure will be described with reference to FIG. **30**. FIG. **30** is a side view illustrating the thirteenth embodiment.

In this embodiment, the downstream-side support portion **606** is provided with a tension application member **661** that applies a tension to the regulation member **604**. Furthermore, the upstream-side support portion **605** may be provided with the tension application member **661** instead of the downstream-side support portion **606** or along with the downstream-side support portion **606**.

Since the tension application member **661** is provided, a tension is reliably applied to the regulation member **604**, and hence the regulation member **604** may be held at a necessary position.

Next, a fourteenth embodiment of this disclosure will be described with reference to FIG. **31**. FIG. **31** is a side view illustrating the fourteenth embodiment.

In this embodiment, a regulation member **604**A is formed as an elastic member.

Thus, a tension may be obtained by the regulation member **604**A without providing a separate tension application member as in the thirteenth embodiment.

Next, a fifteenth embodiment of this disclosure will be described with reference to FIGS. **32** and **33**. FIG. **32** is a side view illustrating the fifteenth embodiment, and FIG. **33** is a plan view illustrating the fifteenth embodiment.

In this embodiment, in the configuration of the thirteenth embodiment, the upstream-side support portion **605** is provided with a tension release member **662** that releases the tension of the regulation member **604**. The tension release member **662** is adapted to be separated when a predetermined amount or more of force is applied to the regulation member **604**. For example, the tension release member **662** is fixed to a support portion **5** through a pawl portion, and the pawl-shaped portion is adapted to be separated by a predetermined amount or more of force.

Further, a tension restoration member **663** is provided which restores the tension released by the tension release member **662**.

With such a configuration, when a large force is applied to the regulation member **604** due to the sheet in the event of the jam, the sheet lifts the regulation member **604** upward. Thus, when the regulation member collides with (interferes with) the recording head **601**, the tension of the regulation member **604** is released by the tension release member **662**. When the tension of the regulation member **604** is released, the allowance length of the regulation member **604** increases.

Since the allowance (the length) of the regulation member **604** increases due to the release of the tension, the damage of the regulation member **604** or the degradation in operability for the jam clearance may be prevented.

Further, since the projection of the tension release member **662** is guided by the tension restoration member **663** in a manner such that the tension release member **662** which is separated once moves the regulation member **604** to the position of the tension restoration member **663**, the tension may be returned to the tension generation position.

The tension restoration member **663** is not limited to the guide type, and may be operated by the power of an actuator such as a motor or a solenoid. Further, the tension release member **662** may not be held by the pawl-shaped portion, and may be held by the other holding unit such as a magnet.

Next, a sixteenth embodiment of this disclosure will be described with reference to FIG. **34**. FIG. **34** is a side view illustrating the sixteenth embodiment.

In this embodiment, an apparatus body includes therein an image forming section **902** as an image forming unit, a conveyance assembly **905** as a conveyor, and the like, and a sheet feed tray **904** capable of stacking a sheet **910** as a recording medium thereon is provided at the lower side of the apparatus body. Furthermore, the sheet feed tray **904** is used as a sheet feed unit while including a sheet feed cassette.

Then, the sheet **910** fed from the sheet feed tray **904** is obtained, and the image forming section **902** records a necessary image by ejecting a droplet in the horizontal direction while the sheet **910** is intermittently conveyed in the vertical direction by the conveyance assembly **905** as the conveyor. The sheet **910** having an image formed thereon is further conveyed upward through a sheet discharge conveyance section **906**, and is discharged to a sheet discharge tray **907** as a sheet discharge unit provided at the upper side of the apparatus body.

Here, the image forming section **902** movably holds a carriage **923** equipped with a recording head **924** by a main guide member **921** and a sub-guide member **922**. The carriage **923** moves while performing a scan operation in the main scanning direction through a timing belt stretched between a driving pulley and a driven pulley by a main scanning motor of a carriage moving assembly.

The carriage **923** is equipped with a recording head **924** as a liquid ejection head used to eject ink droplets of respective colors of yellow (Y), magenta (M), cyan (C), and black (K).

The recording head **924** is attached so that the droplet ejecting direction becomes the horizontal direction while nozzle rows each having a plurality of nozzles are arranged in the sub-scanning direction perpendicular to the main scanning direction. That is, employed is a horizontal typing type including the recording head **924** in which a nozzle face provided with nozzles for ejecting a droplet is disposed in the vertical direction and a droplet is ejected in the horizontal direction.

The sheet **910** of the sheet feed tray **904** is separated one by one by a sheet feed roller (semi-lunar roller) **943** and a separation pad **944**, and is fed into the apparatus body. The fed sheet **910** is conveyed to a gap between a pressing roller **948** and a conveyance belt **951** of the conveyance assembly **905**, and is conveyed while being adsorbed to the conveyance belt **951**.

The conveyance assembly **905** includes the endless conveyance belt **951** which is stretched between a conveyance roller **952** as a driving roller and a driven roller **953** and a charging roller **954** which charges the conveyance belt **951**.

Further, the pressing roller **948** is held by a leading-end pressing plate **955**. Further, a spur roller **958** opposing the driven roller **953** is provided.

The sheet discharge conveyance section **906** includes a sheet discharge conveyance roller **961**, a conveyance roller **962**, a spur roller **963**, a sheet discharge roller **964**, a spur roller **965**, a guide member **966**, and the like.

Then, in the image forming apparatus, the front surface side of the apparatus body is provided with a front cover **801** as an openable cover which is openable and closable about a support shaft **802**. Further, the conveyance belt **951**, the conveyance roller **952**, the driven roller **953**, and the sheet discharge conveyance roller **961** are integrated with as a conveyance unit **700** as a conveyance section. Then, the conveyance unit **700** is provided so as to be openable and closable about the shaft of the conveyance roller **952**.

Thus, a conveyance passage **960** may be opened by opening the front cover **801** and the conveyance unit **700**.

Even in the image forming apparatus with such a configuration, a regulation member may be provided as in the ninth to sixteenth embodiments.

In this way, in the case of the configuration in which the conveyance passage **960** is opened in the event of the jam, the pressure of the sheet caused by the jam opens the conveyance unit **700**, and hence the operation of the regulation member is not needed.

Here, in the case of the jam in which the sheet is tangled by the regulation member, it is desirable that the sheet move in a direction in which the sheet collides with the regulation member (that is, the recording head moving direction) due to the jam.

At this time, in the case where the strength of the regulation member is not strong, there is a possibility that the regulation member may be damaged when the regulation member moves before the conveyance unit is opened, and hence it is desirable to move the regulation member after the conveyance unit is opened.

Numerous additional modifications and variations are possible in light of the above teachings. It is therefore to be understood that, within the scope of the above teachings, the present disclosure may be practiced otherwise than as specifically described herein. With some embodiments having thus been described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the scope of the present disclosure and appended claims, and all such modifications are intended to be included within the scope of the present disclosure and appended claims.

What is claimed is:

1. An image forming apparatus comprising:

an image forming unit to form an image on a recording medium;

a conveyor disposed opposing the image forming unit to convey the recording medium in a medium conveyance direction along a conveyance passage at which the image forming unit forms the image on the recording medium; and

a string-shaped regulation member having two open ends and extending from one open end thereof up stream in the medium conveyance direction to the other open end thereof downstream in the medium conveyance direction, the string-shaped regulation member being disposed between the image forming unit and the conveyance passage at which the image forming unit forms the image on the recording medium, to regulate a distance between the recording medium and the image forming unit within a certain range.

2. The image forming apparatus according to claim **1**, further comprising:

a guide member to support the regulation member at an upstream side and a downstream side from the image forming unit in a medium conveyance direction of the recording medium,

wherein the guide member is disposed so as to be movable in a direction perpendicular to the medium conveyance direction.

3. The image forming apparatus according to claim **1**,

wherein the guide member is disposed at a same side as a side at which the image forming unit is disposed, relative to a position of the regulation member between the image forming unit and the conveyance passage.

4. The image forming apparatus according to claim **1**, further comprising a holder to hold the regulation member; and

an elastic member via which the holder holds the regulation member.

5. The image forming apparatus according to claim **1**, further comprising:

a rotary body disposed at at least one of an upstream side and a downstream side of the image forming unit in a medium conveyance direction of the recording medium,

wherein the regulation member is disposed so as to pass a side opposite to the conveyance passage relative to the rotary body.

6. The image forming apparatus according to claim **1**, further comprising a holding portion to hold at least one end of the regulation member,

wherein the holding portion is separately provided from the guide member, and the guide member holds a halfway portion of the regulation member.

7. The image forming apparatus according to claim **6**, further comprising a carriage mounting the image forming unit,

wherein the holding portion is disposed outside a scanning area of the carriage.

8. The image forming apparatus according to claim **6**,

wherein the holding portion is provided in a conveyance passage forming member or a member holding the conveyance passage forming member.

9. The image forming apparatus according to claim **6**,

wherein the guide member includes a laid portion having an obtuse or a curved shape on which the regulation member is laid.

10. The image forming apparatus according to claim **1**, further comprising:

a wiping member to wipe off a circumferential surface of the regulation member.

11. The image forming apparatus according to claim **1**,

wherein the conveyor includes a conveyance guide member to guide the recording medium and a guide member to support the regulation member at an upstream side and a downstream side of the image forming unit in a medium conveyance direction of the recording medium, and the guide member is provided on the conveyance guide member so as to be movable in a direction perpendicular to the medium conveyance direction.

12. The image forming apparatus according to claim **11**,

wherein the guide member includes

an upstream-side holding portion to support the regulation member at the upstream side of the image forming unit in the medium conveyance direction,

a downstream-side holding portion to support the regulation member at the downstream side of the image forming unit in the medium conveyance direction,

a connecting portion to connect the upstream-side holding portion and the downstream-side holding portion to each other, and

a moving member disposed at a first side of the conveyance guide member opposite a second side of the conveyance guide member at which the conveyance guide member guides the recording medium, the moving member being movable in a direction perpendicular to the medium conveyance direction, and

wherein the connecting portion is attached to the moving member.

13. An image forming apparatus comprising:

an image forming unit to form an image on a recording medium;

a conveyor disposed opposing the image forming unit to convey the recording medium in a medium conveyance direction along a conveyance passage at which the image forming unit forms the image on the recording medium, the conveyor including a pair of upstream-side rotary bodies at an upstream side of the image forming unit in the medium conveyance direction of the recording medium and a pair of downstream-side rotary bodies at a downstream side of the image forming unit in the medium conveyance direction; and

a regulation member including a string-shaped member having two open ends and extending from one open end thereof upstream in the medium conveyance direction to the other open end thereof downstream in the medium conveyance direction, the string-shaped regulation member being disposed between the image forming unit and the conveyance passage at which the image forming unit forms the image on the recording medium, to regulate the recording medium, the regulation member further including an upstream-side support portion at an upstream side of the image forming unit in the medium conveyance direction to support the string-shaped member at the upstream side and a downstream-side support portion at a downstream side of the image forming unit in the medium conveyance direction to support the string-shaped member at the downstream side,

the regulation member additionally including a portion that is disposed between the pair of upstream-side rotary bodies and the image forming unit and extends in a vertical direction relative to the conveyance passage.

14. The image forming apparatus according to claim **13**, further comprising a driving assembly to move the regulation member in a direction perpendicular to the medium conveyance direction,

wherein, relative to the conveyance passage, the driving assembly is disposed at a same side as a side at which the image forming unit is disposed.

15. The image forming apparatus according to claim **13**, further comprising a tension application member to apply tension to the string-shaped member.

16. The image forming apparatus according to claim **15**, further comprising a tension release member to release tension to the string-shaped member.

17. The image forming apparatus according to claim **13**, wherein the string-shaped member is an elastic member.

18. The image forming apparatus according to claim **13**, further comprising a driving assembly to move the regulation member in a direction perpendicular to the medium conveyance direction,

wherein, in response to detection of a jam of the recording medium, the driving assembly retracts the regulation member.

19. An image forming apparatus comprising:

an image forming unit to form an image on a recording medium;

a conveyor disposed opposing the image forming unit to convey the recording medium in a medium conveyance direction along a conveyance passage at which the image forming unit forms the image on the recording medium, the conveyor including a pair of upstream-side rotary bodies at an upstream side of the image forming unit in the medium conveyance direction of the recording medium and a pair of downstream-side rotary bodies at a downstream side of the image forming unit in the medium conveyance direction; and

a regulation member including a string-shaped member having two open ends and extending from one open end thereof upstream in the medium conveyance direction to the other open end thereof downstream in the medium conveyance direction, the string-shaped regulation member being disposed between the image forming unit and the conveyance passage at which the image forming unit forms the image on the recording medium, to regulate the recording medium, the regulation member further including an upstream-side support portion at an upstream side of the image forming unit in the medium conveyance direction to support the string-shaped member at the upstream side and a downstream-side support portion at a downstream side of the image forming unit in the medium conveyance direction to support the string-shaped member at the downstream side,

the regulation member additionally including a portion that is disposed between the pair of downstream-side rotary bodies and the image forming unit and extends in a vertical direction relative to the conveyance passage.

20. The image forming apparatus according to claim **1**, further comprising:

an upstream-side holder coupled to, and holding, the one open end of the string-shaped member, upstream in the medium conveyance direction; and

a downstream-side holder coupled to, and holding, the other open end of the string-shaped member, downstream in the medium conveyance direction.

* * * * *